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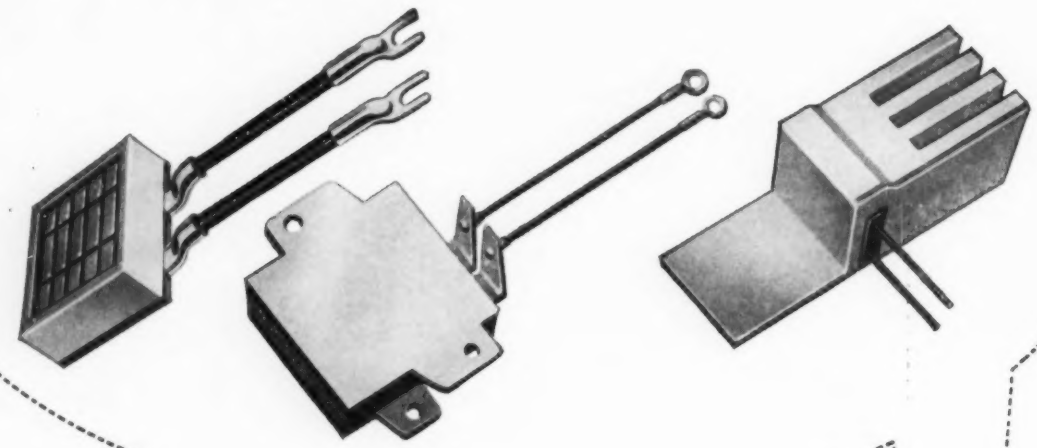

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July 3, 1961 Vol. 32, No. 27

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INTERESTING TO NOTE

On our cover–coffee making machine that brews a "perfect cup" of instant coffee. Developed by the General Foods research staff and their industrial design consultants Walter Dorwin Teague Associates, design details are on page 16. Left to right—Russell Kramer and George M Woodruff, General Foods Corp; Robert H Ensign and Milton Immermann, Walter Dorwin Teague Assoc.

If an army travels on its stomach, coffee serves as its lubricant. For that matter, the coffee-drinking habit has played such an important part in our lives that portions of our daily working routine are set aside for its consumption, shops have been established for the sole purpose of drinking coffee–its extract even finds its way into candies, cakes, ice cream, sauces, and the flavored milk for children "too young" to drink coffee "straight." Perhaps no other food has affected the economic conditions of so many countries as has coffee. Originally called "quhwah" (Arabic for *strength*), it was first discovered by a goatherd around 850 AD. By the 14th century it had spread throughout Europe. Today, coffee, as a beverage, is consumed by 130 million Americans (the average adult: over 20 lb annually).

The actual preparation of the cup of coffee has had quite an evolution. For centuries, the only known way was by boiling, and naturally, there were multitudinous ideas on how to boil. Nevertheless, the results were inevitably the same–a bitter beverage that, today, we wouldn't dream of trying. Then, in 1702, came the French novelty of steeping coffee. Receptive to new culinary ideas, Frenchmen gradually adopted the new method, and in 50 years had abandoned boiled coffee altogether.

The next step came in 1800 when DeBelloy invented the French drip pot (percolator, as it was then called). His method so inspired other inventors that an avalanche of patents for "improved" drip pots, including the modern pumping percolator, were issued in England, France, Germany and the United States. The public, caught up in the excitement of the Industrial Revolution, was eager for any innovation, especially one that could be pleasurably used in the home. Coffeepot inventors had a field day. Among those who used the DeBelloy percolator as a guide was the American Count Rumford. He devised a pot that compressed the coffee in a filter compartment, preventing it from being agitated by the water.

Then, in 1840, Scottish marine engineer Robert Napier turned his attention from ships to coffee pots and invented an elaborate vacuum machine. His device was never patented, but 30 years later it was being manufactured in Glasgow in the works of Thomas Smith & Sons.

The device, a handsome piece of craftsmanship that would look at home in a dining room or a chemical lab-

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oratory, consisted of a silver globe, a mixing container, a syphon and a strainer. A small amount of water was put in the globe and heated by a gas burner. Meantime, boiling water was added to dry coffee in the mixing container. Steam pressure in the globe forced steam through the tube into the coffee mixture, causing the mixture to become temporarily agitated. Then when the flame under the globe was lowered, the steam condensed and a vacuum was formed. As if by magic, the vacuum pulled clear coffee back through the filtered tube into the globe, and the coffee was ready to serve.

Scientific Islander

As the president of Stevens Institute of Technology points out in his article on page 46, R & D today is hindered by three problems: the general public has been oversold, researchers are more concerned with money than with solving problems, and engineers are not making best use of available results. Research today is big business. Companies are established for the sole purpose of investigating new products and processes . . . the government has organized groups attempting to find better ways to solve problems . . . large grants are bestowed on individuals to aid their search into the unknown.

Thomas Edison was the first to establish a research group in America, but Tycho Brahe had the world's first research institute in operation several centuries earlier. Brahe, one of the foremost astronomers of his time, was probably the first ever to convince a government of the necessity to invest money in basic research. In the mid-16th century, King Frederick II of Denmark gave Brahe a small grant to pursue pure science. He also gave him the island of Hven, in the bay off Elsinore, on which to build his research laboratory. In 1580 the building was ready for occupancy. Called Uraniborg ("Castle of Astronomy") the building housed a library, a series of laboratories, several observatories and living quarters for the scientists. On the laboratory grounds, Brahe also constructed a paper mill and printing shop, an instrument maker's shop—and also an auxiliary underground observatory protected from the high winds.

The lab was used by Brahe and his assistants as well as a select group of "Research Fellows and Visiting Scholars" from all over Europe. Unfortunately, the laboratory only lasted 17 years. In 1597, Brahe fell from grace and was forced to leave Uraniborg for Prague. Science had lost out to politics.

Add to engineer's bookshelf

Several years ago, Richard Koff, now assistant managing editor, assembled a list of books he felt belonged in an engineer's library. His bibliography was so well received that it has now been updated twice, see page 25. In his listing, however, is an omission which can only be attributed to modesty. *How Does it Work?*, written by Richard Koff, is to be published next week by Doubleday & Company. In this book Koff starts with the familiar aerosol can and ends up talking about zippers. In between he discusses such items as clocks, electricity, plastics, high fidelity, typewriters—to name but a few. Although the book won't help the engineer solve his particular design problem, it will reveal the answers to that question so often asked of him, "How does it work?"

—Benedict A Leerburger Jr

NEXT WEEK IN PRODUCT ENGINEERING

. . . 7 steps to cleaner fluid systems

Anticipate the contamination problems before they occur—and you can design a fluid system that won't fail.

. . . What goes into rubber?

The filler being added to the mix may be only one of 10 or 20 ingredients in an engineered elastomer.

. . . New AGMA classification system for gears

It covers spur, helical and herringbone gears, sets up 16 new quality classes and expands backlash classes of fine-pitch gears.

. . . Unconventional power sources

Research promises a variety of new ways to generate power. Here's how they work, and what their prospects are.

. . . Torque-limiters protect light-duty drives

Eight devices to disconnect breakable parts from dangerous torque surges.

WHAT'S HAPPENING IN RESEARCH...

Exploding foil tests plastic film

The ultrahigh pressures produced by explosion of thin metal foil (*PE—Feb 10 '58, p 14*) are being used to accelerate "slapper plates" to velocities on the order of 0.1 cm/microsec and propagate plane-uniform high-pressure shock waves into polyester film targets. The slapper plates are driven directly out of a larger sheet or spalled off an intermediate attenuator sheet, and the velocity is measured by standard techniques.

J. P. Penning Jr and D. V. Keller of Boeing, who described the system at the APS summer meeting, are now using 0.0005-in. aluminum foil to accelerate the slapper, and exploding the foil with the discharge of a 15-μf, 20-kv condenser.

How water attacks steel and aluminum

Of the impurities commonly found in water—chlorides, sulfates, bicarbonates, silicates—the first two are most corrosive to steel, with either one of them having relatively severe effects.

On aluminum, though, L. C. Rowe and M. S. Walker of GM Research Labs told a Chemical Specialties group, "no single impurity affects corrosion to the degree that mixed impurities do." For instance, a solution containing salts of copper, chlorides and bicarbonates, was found to have a marked accelerating effect on the corrosion rate of aluminum, considerably greater than that of any single constituent, but degree of pitting, they found, depends on temperature as well as impurity concentration.

Additional studies are now in progress to learn more about this synergistic effect; and other studies of neglected corrosion sources are also underway.

Radioisotope measures surface roughness

A system that uses radioiodine to measure surface roughness is being developed at U of Arkansas as one of several new routes to simpler, more reproducible surface-measurement techniques.

The isotope system is based on the correlation between surface area and gas adsorption: the rougher the surface, the greater its area and therefore the more gas adsorbed per unit section.

Ordinarily, it would be difficult if not impossible to measure the minute amounts of gas involved. The radioisotope simplifies the job.

The sample is prepared, cleaned, and checked with a radiation detector to measure its background level of radiation. Next, it's exposed to radioactive-iodine vapor. A second radiation count then determines the amount of radioiodine pickup and therefore the roughness of the surface as compared to a standard sample (highly polished gold foil).

The technique is still in early development, but adsorption factors have been worked out for several metals, and a preliminary report has been prepared—available through OTS, Dept of Commerce, Washington 25, DC (PB 161,844, 48 p, $1.25). Also available from OTS is a report on another approach to the problem—measurement of polarization capacitance. This is PB 161,487, 39 p, $1.

Conductivity cell simplifies electrolyte studies

A conductivity cell that is virtually independent of frequency in the 500 to 5000-cycle range, even at resistances on the order of 1000 ohms, has been designed at Brown U; and, says Prof R. L. Kay, it can be used with any bridge that has a Wagner-type ground.

Guarded platinum electrodes can be dipped into the solution, and the solution can be stirred while the measurement is being made, reducing temperature gradients and simplifying temperature control.

The cell itself is made of Pyrex glass and has an opening at the top so salt additions can be made without disturbing the electrical system.

A description of the cell is being prepared by a student working under Kay; should be available within a few months. —ARG

Laser for the lab

RUBY LASER for experimental work is now available from Raytheon Manufacturing. The laser (an optical maser) generates a high-intensity light beam of controlled frequency, may be used for light-amplification, communications, and perhaps a concentrated heat source. Price for this unit: $5850, including laser head (with chromium-doped ruby and xenon flash tube) and power supply.

DEVELOPMENTS TO WATCH...

Grinders reach 300,000 rpm, head for 350,000

Already in production with 300,000-rpm grinders that have a continuous service life well over 260 hr, Vulcan Tool Co is now heading for the 350,000-and-more range. But, says Ralph Guess, Vulcan chief engineer, three big problems remain to be solved:

The easiest is simply one of design and production—getting a smaller rotor.

Next is lubrication. "What we need," says Guess, "is just one drop of oil—misted in 2 cu ft of air/min." About a dozen lubricant suppliers are at work on the problem. But none has come up with a really good solution.

Finally, the problem of harmonics—noise: As speeds go up, the sound of operation becomes a serious annoyance. One approach is use of odd and even numbers of balls—6 at one end and 7 at the other, for instance. But the problem is far from licked. Nevertheless, Guess believes a 350,000-rpm unit will be possible, probably within a year; and, he says, "we'll get to a million if there's any demand for it."

Lighter price for heavy metal

If you're looking for a new material for flywheels and counterweights, take another look at uranium. The "natural" metal is pegged at $24/lb; but "depleted" uranium—exactly the same in every respect except for lower content of the fissionable isotope—is just a little over $1/lb. (The AEC's latest price list shows fully depleted uranium—less than 0.4% U 235—at $2.50/kg.)

Uranium, twice as heavy as lead, is suitable for many applications of the type that now use the "heavy metal" tungsten alloys, and can also be used for radiation shielding.

This metal shows promise as an alloying element too (*PE*—Mar 21 '60, p 8 and Aug 1 '60, p 11). Latest report from Canada's Dept of Mines says as little as 0.02% uranium in 0.40% carbon steel significantly reduces acid pitting. Salt water corrosion tests are now underway. Fatigue strength and elevated temperature properties are improved too. Says S. L. Gertsman of the Dept of Mines: Stress-rupture tests of uranium-bearing SAE 1010 and 1040 steels show "a very significant" increase in stress-rupture life.

There is evidence, too, that uranium can increase the hardness of copper alloys, and may have a beneficial effect on aluminum, magnesium, and zinc. Work on these alloys is, however, still in its early stages.

Cut-rate thermoelectrics claimed by Japanese

Thermoelectric elements for panel cooling-systems, refrigerators, and "thermopacs," for less than $3 a pair. That's the claim of Sanyo Electric. And, the Japanese company says, when its new Osaka plant is finished next month, it will be able to produce about a million a year.

These are bismuth telluride elements, combined into modules containing 10 pairs each. The refrigerator uses 16 such models; the thermopac, 12; the panel systems, 88. Based on Sanyo's present prices, this means thermoelement cost for the refrigerator totals about $450. That's not cheap; but, Sanyo says proudly, it's 25% below the cost for any other Japanese manufacturer. It's considerably below US costs too. A recent price list by one US supplier shows a rock-bottom price for a 16-element module of about $70, or $700 for a comparable refrigeration system.

REFRIGERATOR is one of several low-cost thermoelectric units being readied for commercial introduction in Japan.

Group of new nylon resins coming

A new series of nylon resins, basically type 66, is being readied for commercial introduction by Belding-Corticelli Industries. First offered will be a natural, nearly colorless resin with a heat-distortion temperature of 410 F at 66 psi (174 F at 264 psi); a dielectric strength of 380 v/mil; moisture absorption, 0.9%, and tensile strength, 10,200. This material is now available in sample quantities, should be in full production early next year. Later, BCI plans to expand the line to include a full range of colors and stabilized grade.

Information may be obtained from H. K. Smith, Belding-Corticelli Industries, 1407 Broadway, New York 18.

These single crystals may hold complete circuits

A well-known material, rutile (titanium dioxide) in single-crystal form may provide a medium in which entire circuits can be created for microelectric devices.

By varying the oxygen vacancy density in the rutile crystal lattice, L. E. Hollander Jr of Lockheed says, it's possible to achieve a complete transition from an insulator (10^{13} ohm cm) to a conductor (10^{-4} ohm cm). Furthermore, in the intermediate region (10^{2} to 10^{6} ohm-cm), it shows dielectric constants as large as 10^{6}. It also has anisotropic conductivity "in excess of 1000 to 1" at room temperature. There is evidence, too, of tunneling in thin films.

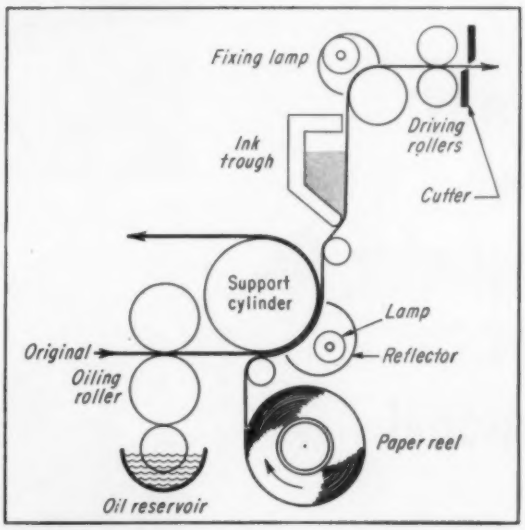
By taking advantage of these facts and varying the oxygen vacancy density, Hollander told a recent electro-optical systems conference, it should be possible to create a complete circuit function in a single rutile crystal.

New copying system does it with "selective distillation"

A process that reproduces text, drawings, and photos—in black-and-white or color—on paper, plastics, foil, fabric, film and rubber has been developed in Britain, and is now headed for commercial application.

Its inventor, Abram Games, says it can be used for computer inputs and outputs and will make offset litho master copies as well as perform the usual office jobs.

A company, Imagic Ltd, has been formed in London to develop the process and commercial equipment is now being designed. First will be a typewriter-size, fully automatic model that will operate at speeds to 60 fpm; much higher speeds are believed possible.



OIL DISTILLED from master to copy, serves to attract and hold the ink that reproduces the image.

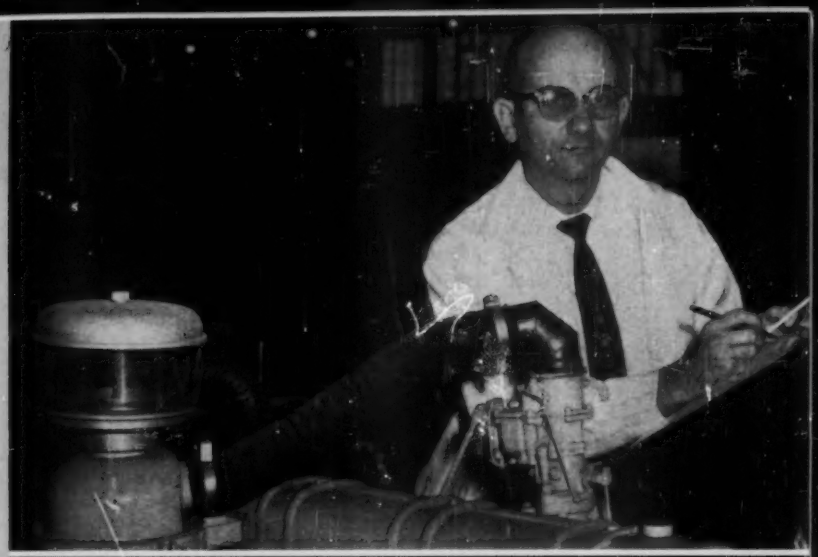
The system gets its name from the fluid that does the work. Almost any distillable liquid (a light oil, for instance) which can be selectively evaporated from areas of unequal temperatures will serve, but the process is the reverse of normal procedures in several ways. It is the original, not the copy paper, which is sensitized. This is done by depositing a very thin film of fluid on it. Then the original is placed in contact with the copy paper (see diagram) and exposed to an infrared lamp. The black (print) areas absorb heat, distilling the fluid onto the copy paper and transferring the image. The image is then "developed" by sprinkling powdered thermosetting resin over the copy. It adheres to the areas on which fluid has been deposited, and is "fixed" by a secondary application of the heat.

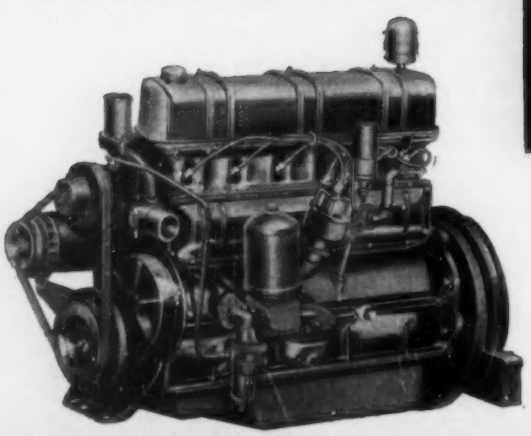
To avoid mirror-imaging when opaque paper is used, a primary copy is made to serve as the master. When transparent paper is used, or when mirror-imaging is not objectable, this step can be eliminated.

Games claims the fluid does not in any way injure the original. —ARG

How to design SALES POWER into your products

Here's why Kershaw Manufacturing Co. specifies International Power





An International UB-220 gasoline engine powers this Kershaw Ballast Regulator. The machine works in either direction, has forward and reverse speeds up to 26 mph. Engine accessibility promotes quick and easy service—another International feature.

CIRCLE 8 ON READER SERVICE CARD

ENGINEERING . . . **Chief Engineer John Holley** backs up his preference for International power with these facts: "We specify International engines for our heavy-duty machines because they best meet the demands of the job. The wide range of sizes, choice of fuels, and power adaptability let us fit the engine to exactly meet machine requirements. Design problems are virtually elimtnated, and we get excellent cooperation and assistance from IH engineers."

SALES . . . . . . **Vice President R. C. Crosby** has this to say about the selling advantages of International power: "Kershaw customers want equipment that will deliver maximum dependability at lowest cost. Our experience, over many years, proves that International power meets these high standards of efficiency. Also, replacement parts are readily available. Maintenance of RR right-of-way often takes our machines to remote areas, but IH engine distributors or dealers are always nearby."

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FROM WASHINGTON . . .

Congressional urging may lead to White House science council

Congress wants a permanent science and technology council established in the White House. And the legislators want the White House to submit an organizational plan to create the new office by next January.

Congressional approval of the measure would make the council a permanent part of the executive offices much like the present space council and the Council of Economic Advisers. Thus, it would not be subject to abolishment from one president to another.

Lack of over-all control over $9 billion or more spent each year by the federal government for research is the key reason for the move. Congress, at present, doesn't think there is sufficient coordination in research programs. And, significantly, it doesn't have any single agency that can report—or be held responsible—for total government research.

Establishment of the new office is viewed as a compromise step between Congressional advocates for a whole new cabinet level office of science and technology that would lump all federal research and development under one agency, and those that merely want stronger guidance for the program.

White House compliance with the request is sure to come. Just recently, Dr Edward Wenk, Jr, senior specialist in science and technology at the Library of Congress Legislative Reference Service, was appointed to serve as the executive secretary of the Federal Council for Science and Technology. This council was established by executive order back in 1959, but was never fully staffed.

Actually, the White House is now moving in the same direction to beef up coordination of R & D that Congress wants. The chief difference is that Congress wants the organization to be given a permanent status.

NSF predicts doubled technical manpower needs

The requirements for engineers and scientists by 1970 will double the number employed in 1959. But, the projected input of manpower in these fields won't meet these requirements.

That is what a report to be published in Setember by the National Science Foundation will show. Final drafts of the report, prepared by the Bureau of Labor Statistics, are now being processed.

In the base year, 1959, there were some 800,000 engineers and 300,000 scientists employed both in government and industry. By 1970, twice this number will be needed. This increase will not be uniform, however: the requirements for scientists will increase by a larger percent than engineers. Within the field of engineering, the need for mathematicians will rise the sharpest. In 1959, for example, there were some 30,000 mathematicians employed. By 1970 the requirement will increase two to three times.

Manned buoy will aid ocean research

Two giant research buoys for ocean research will be put into service late this year. A 355-ft long buoy with a 20 ft base dia is being built by Scripps Institution of Oceanography for use in the Pacific. Called FLIP (floating instrument platform) the vessel will be towed out to sea where it will be flooded so that it floats upright with over 300 ft of its structure below the surface. A four-man scientific team will man the free floating buoy for up to two-week periods.

A similar, but slightly smaller, buoy will be built by the Naval Ordnance Lab for research in the Atlantic. Called SPAR (seagoing platform for acoustic research) the Navy's buoy will be unmanned, but tended by two ships.

British engineering excites Soviet interest at trade fair

- **Fairgoers ask probing technical questions**
- **Russians want automatic equipment**
- **British visit plants; see nothing startling**

Moscow—When the Soviet Union turns to the West for engineering equipment, it wants high-precision machinery – preferably automatic – that can be operated by a semi-skilled work force. This is the impression carried away by exhibitors at the big British Trade Fair in Moscow which attracted more than 1,250,000 Soviet visitors during its 17-day stand.

Engineering, electronics and scientific instrument exhibitors constituted a substantial number of the 725-odd firms making the long, expensive trek to the Soviet capital for what proved to be the most successful commercial fair ever staged in the USSR. Its "strictly business" approach pleased the Russians, including Premier Nikita Khrushchev, who personally assured the British their fair was vastly superior to the US exhibit in 1959 which emphasized the American standard of living.

Only a half-dozen machine-tool makers participated in the British show. Others backed out because of high transportation and exhibition costs. But electronics manufacturers showed up in force with small-craft radar, TV cameras, radio telecommunications systems, radio direction-finders and electronic instrumentation and control equipment.

Instrument makers showed high-speed cameras, vibration generators, signal generators, oscilloscopes and similar equipment. Eight electronic items on the strategic embargo list—and therefore banned for sale to the Soviet Union—were brought to Moscow by exhibitors who apparently hoped the ban would be lifted by a sympathetic British government. It wasn't.

Many British businessmen, mindful that the USSR now has a large engineering industry of its own, are convinced it is pointless to try to sell the Russians standard equipment.

RUSSIAN CITIZENS attend British trade fair in Moscow.

As one machine tool man put it, "Nowadays, the Russians have engineers quite capable of coming up with good designs but their labor force is not always of the highest caliber." Hence they are in the market for accurate, highly productive equipment that can be operated easily.

Machinery displayed at the fair, and Soviet reaction to it emphasized this new point:

- Scottish Machine Tool Corp excited Russian interest with its cold hydraulic ship frame bender. Company officials said it was the first ever shown in the USSR and they were invited to lecture on the machine to the State Committee for Shipbuilding.
- BSA Tools Ltd found the Russians most interested in its automatic chucking machine, featuring a disk program-control unit.
- Coventry Gauge and Tool Co. exhibited a two-way tap grinding machine, described as the fastest in the world.
- Dowding and Doll Ltd brought along its Universal Hobbing Machine and a multiple station Wiedeman turret punch press, which can be run by a relatively unskilled operator who merely follows a color code on a template.
- Churchill Machine Tool Co, showed three types of precision grinding machines, all capable of operating as part of an automatic line.

Ticket distribution was handled by the Soviets. Visitors were apparently brought from all over Russia. Pye, Ltd reported talks with people from as far away as Siberia. The ticket holders grabbed up technical sales brochures as fast as they were laid out. In fact, after the first day, most companies put their literature under lock and key to control distribution. As a rule, the technical level of inquiries from morning visitors – when admittance was restricted to representatives of Soviet industry – was described as "quite high." Not only were the questions often detailed and technical, but many visitors showed up with pad and pencil in hand to sketch components of particular interest to them.

HOW SUCCESSFUL?

By and large, the British were satisfied with results. It is doubtful that the fair paid its way, short range—that is, in sales generated on the spot. But long range it should prove worthwhile for companies new to the Soviet market and the "old hands" who have been dealing with the Russians for years.

More than £10 million in sterling

contracts (roughly $28 million) were announced during the show, though the big ones had been negotiated earlier. These included a Vickers contract to supply a complete plant for production of nylon-66 industrial fiber; a Coventry Gauge and Tool contract to sell 24,000 lb of gear- and jig-grinding machines; and Hawker Siddeley receipt of firm orders for 500,000 lb of electrical power equipment. The Pye Group, which has had a successful record of selling to the Soviets for years, is optimistic that it will sell another instrument landing system for Moscow's Shermetyevo Airport. It has already sold two to the Soviets.

There were some irritants. An expensive industrial microscope disappeared right off the stand of an instrument manufacturer. Exhibitors were discouraged from building up sales contacts. One company asked visitors to leave their names and addresses. It was advised by the Soviets to cease.

Most companies managed to find purchasers for equipment they brought to Moscow, though some of the electronic exhibitors had to ship their wares back home. As for the consequences of these sales, one metalworking exhibitor was asked what would prevent the Soviets from buying one machine, then making their own copies.

"They can copy the design," he replied. "But that doesn't mean the copy will have the accuracy of the original, or that it will be made from materials necessary for high precision, or that the high quality cutting oils will be used."

Curiously, the questions most frequently posed by Soviet visitors to the machine tool stands were: What is the composition of the cutting wheel? What is the degree of accuracy? Some visitors even took their own accuracy measurements.

For their part, the British got a limited look at Soviet industry in visits to a few plants and to the Permanent Exhibition of Economic Achievements. One machine-tool manufacturer was considering purchase of a lathe from the Krasnii Prolaterii Plant, whose mass production of relatively simple machine tools has stirred fears that the Soviets will successfully invade Western European markets.

"I want to take it home and give it a good going over. I think it will pay us to keep up with what these people are doing."

Metalworking men saw equipment described as the latest in machine-tool developments at the Economic Achievements Exhibition.

"I saw nothing there which isn't already available in the West," commented one visitor. "If that is actually their best, we don't have much to worry about."

—Ernest Conine,
Moscow News Bureau

Better cast iron properties promised by new process

WATERTOWN, WIS.—A line of low-frequency induction-melting and receiving furnaces should reduce the cost of castings, increase uniformity and strength of the material, and permit thinner wall design in all grades of cast irons, say engineers of Hevi-Duty Electric Co, American licensee of Forni Elettrici A Tagliaferri, Italian firm that developed the new equipment. First American installation, starting with a receiving furnace or forehearth, is expected to be operational by July. It will be at the Silbley Machine and Foundry Co, South Bend, Ind.

Strength of cast iron produced by this system is around 20% over that of standard methods. Corrections and changes in the analysis of molten iron can be made in the receiver with a minimum of losses. This permits producing a number of different compositions from the same master melt.

Design of the induction unit is such that the electrical energy which keeps the molten iron at heat also induces a stirring action in the melt. This action can be controlled so as not to extend to the layer of slag and oxides floating on the molten metal, thereby giving a cleaner iron. Also, the graphic flakes are kept small; the combination of clean iron and small graphite flakes is responsible for the higher strength of the product.

In Italy, where some 800 such installations are in operation, the melting furnace replaces the cupola, while the forehearth is used to refine the melt, to bring it and keep it at the pouring temperature, and to make additions.

In the first American installation, the forehearth is planned to be used in conjunction with a cupola. Later, a melting furnace will also be installed.

Metal from the forehearth is poured directly into the molds. The construction is such that poured metal comes from the bottom of the forehearth, to

Plastics lighten landing gear of lightweight plane

Two innovations in aircraft design are claimed for this Swedish four-seater: its fuselage, wings and control surfaces are entirely of sandwich construction and its landing gear is fiberglass-reinforced plastic. The sandwich is aluminum-honeycomb core between aluminum alloy surfaces. The plane's top speed of 150 mph is said to be about 10% greater than that of its competitors. This is attributed largely to the weight-cutting construction, but partly also to the high position of the wings. Expected to be a military reconnaissance or an industrial service plane, it was designed by AB Malmo Flygindustri in close cooperation with Saab and military authorities.

prevent contamination with slag or oxide inclusions.

Also claimed for the new forehearth is increased fluidity of the melt. This permits pouring at lower temperature and allows thinner wall design of cast parts.

In the melting furnace the induction coils are located in the center of the melt. The furnace proper can be lifted from the base-and-coil assembly and replaced with a spare.

In the forehearth the coil is outside the furnace proper; heating occurs in annular chambers surrounding the coil and connected with the bottom of the melt.

Coming—lighter-weight cast-iron parts

DETROIT—Cast-iron parts tend to be heavier than they need be because allowance must be made for irregularities in the molding and for minor shifts that occur in the casting process. A number of advances have been made in the casting process, says C. H. Patterson, Ford vice president for the Power Train and Metal Stamping Group, but up to now they were considered too expensive for application in the casting of gray iron. They were restricted to casting light metals, especially in the aircraft industry.

Now, says Patterson, the techniques can be applied economically to iron castings, and these significant improvements have been added to the "green sand" molding process:

- **Cores made of sand** mixed with a phenolic binder. This replaces the cereal-and-oil binders previously used, and permits repetitive production of accurately shaped cores.

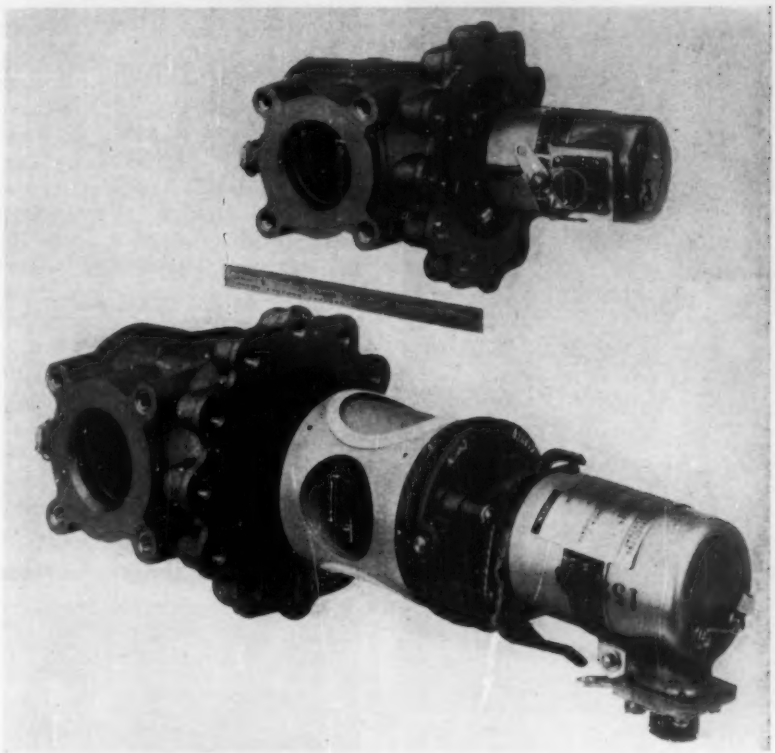
- **Use of preheat boxes** to quick-cure the sand-plastic mixture. This reduces to seconds the time required to cure the cores. Previously cores had to be baked for hours, and were subject to distortion in handling and during baking.

- **Green sand** is packed to higher densities and hardness in the molds by higher pressures of cylinders in the molding machines, permitting greater accuracy of mold cavities.

Ford is expected to use the new process in production of cast iron engines for the 1962 model year, Patterson concluded.

—Felix Giordano, Regional Editor

Secondary seal speeds valve replacement



A 90° counterclockwise twist permits removal of solenoid, actuation mechanism and valve body from housing and lines. Whittaker Controls, Div of Telecomputing Corp, added a secondary seal to close flow ports when valve is removed for replacement. A reverse twist locks new valve in place, releases the seal and clears the lines for flow. Present valve is used in aircraft fuel lines and operates at 60 psig at 135 F. Whittaker claims the valve body protects the valve mechanism and the valve is less prone to leakage as plumbing, once connected, is never removed from the body except to replace O-rings or gaskets. Processing, nuclear and machine-tool industries have expressed interest in the valve, Whittaker reports.

US Patent policy hinders invention, executive warns

LOS ANGELES—The US government is delaying a moon landing by usurping patent privileges of inventors. This charge was raised at the semi-annual meeting of the American Rocket Society and the Institute of the Aerospace Sciences here by Robert R. Lent, vice president of the Strategic Industries Association. SIA is an organization of small- and medium-size defense firms that subcontract to the large West Coast plants.

Lent, who is also a management consultant and vice-president of Riggs Nucleonics Corp, said that he recently testified against the government's present patent policy before the McClellan Committee. He told the legislators that now "the government grants to any and all a royalty-free license to make, use and sell anything to which the US holds title, thereby negating the exclusive feature—and value—of the patent concept." SIA and its members, he said, have pledged to fight such abridgment of patent concepts, and hope to get them reversed soon.

He pointed out some especially objectionable patent policies:

- The Atomic Energy Act in essence gives the government the right to any patent acquired by individuals or businesses working under contract for AEC.

- The National Aeronautic and Space Act makes any invention conceived in performance of any work under NASA contract the exclusive property of the US. This holds true even if the inventor did his work out-

news continued on page 14

news continued from page 13

side business hours and was not even directly assigned to the contract.

Now a new act under consideration will extend the NASA provisions in about their present form to all government work. Business firms, Lent says, have been able to sidestep objectionable provisions by not doing business with the agencies in question. But the legislation, proposed by Senator Long (D-La) will force manufacturers to sell to government agencies, and thereby accept their terms. According to Lent, the Long bill "reverses the right" of business to sell to whom it pleases.

In conclusion, Lent warned that these acts and the proposed bill may dam the flow of new technical ideas by usurping the patent privileges granted by the constitution. All this will handicap, if not paralyze, our scientific assault on the moon and the planets, he said. ■

Job hunting poses few problems for 1961 grads

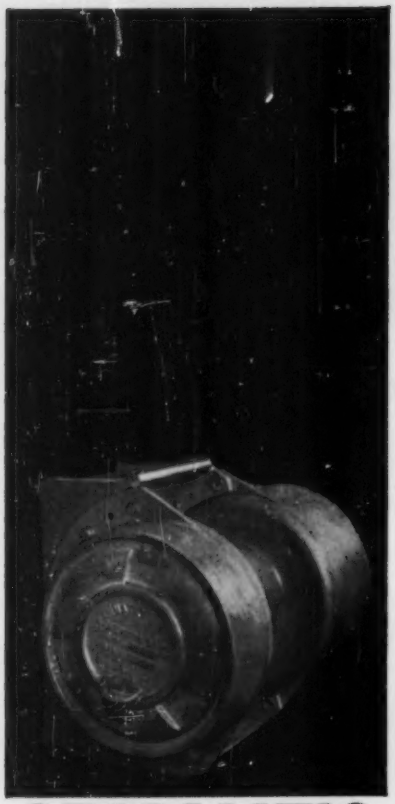
NEW YORK—Despite concern over a tightening market for engineers, there is virtually no slakening in the rate at which recent technical grads are making definite plans for next year.

A survey of 49 schools shows that 83.3% were definitely committed to jobs, military service, graduate studies or some other plans by May 19. This compares with 84.4% last year.

EJC finds that there has been a

Rubber takes what steel can't

A 1/3-in.-thick slab of rubber, in foreground, withstands 5000 F flame of an oxy-acetylene torch that burns through a slab of steel at rear. The rubber, a silicone material, has withstood temperatures to 9000 F in tests. It's been developed by the Silicone Products Dept of General Electric, and is expected to have application as a protective coating for missile and space vehicles.



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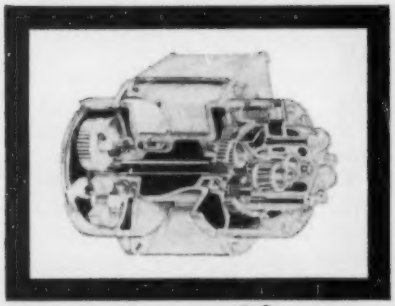

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3% drop in job placements, but this has been compensated by a 2.5% increase in the number going on to graduate study and a 0.9% increase in those heading for military service.

Electrical engineering students have been the most successful in finding jobs. Some 69.5% already have jobs and 8.4% are considering offers. Another 11.1% will continue their studies. Among mechanical engineers, 62.3% have jobs; 10.2% are considering offers and 10% will do graduate work.

Chemical engineers have had a more difficult time—only about half (51%) have definite job commitments and 7.5% are considering positions. About one-fifth (20.9%) are heading on to graduate school.

EJC will make a final report later this summer based on a mid-June survey. It may well show some further changes in career plans. ■

Student loans encourage faculty careers

EVANSTON, ILL.—A serious shortage of engineering college faculty is being attacked by the Ford Foundation with a program of $50,000 grants to ten universities for student loans.

Under terms of the loans, engineers interested in teaching careers, but unable to finance a doctorate, can obtain assistance over a three-year period to a maximum of $10,000. The loans are a supplement to normal graduate student aids and are particularly designed for young men with families.

The loans are afterward "forgivable" at the rate of $1000 a year for each year the student serves as a full-time faculty member in the US or Canada. For students, who change their minds about a teaching career, the loans must be repaid at the rate of $1000 a year, plus interest.

The program is experimental. Initial participating institutions are: Northwestern, Columbia, Iowa State, Minnesota, New York, and Washington Universities, Illinois Institute of Technology, Rensselaer and Virginia Polytechnic Institutes.

Only 500 Americans now receive engineering doctorates each year, Ford Foundation says. Yet it estimates that 1000 additional faculty members are needed each year. The loan program is expected to help correct this situation. ■

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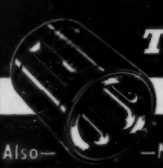

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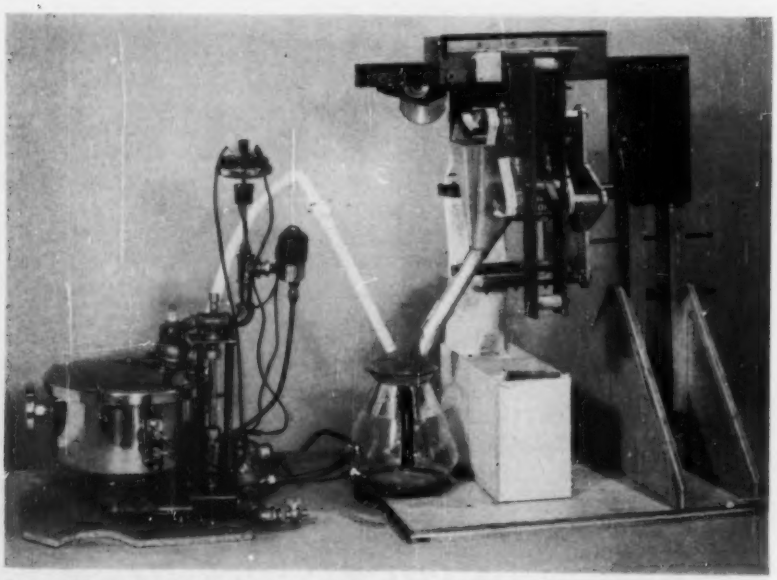
Production model of machine for making coffee automatically from instant.



As working prototype of machine developed by industrial design consultants. Water boiler, with temperature and level control equipment, is at left. Mechanism for feeding, opening and emptying coffee packages into decanter is at right.

Controlled until the last drop

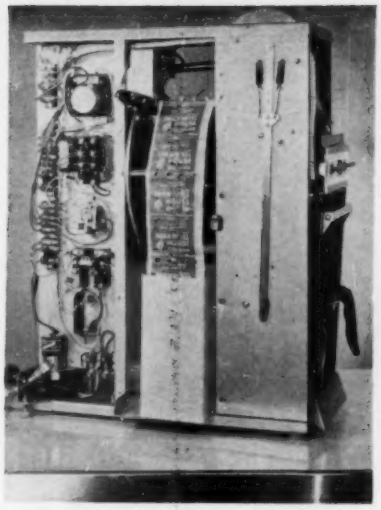
■ One out of every three cups of coffee consumed in American homes today is made of soluble or "instant" coffee. This simpler, quicker and less messy process has always been attractive to the food service field (resturants, lunchrooms, hotels, hospitals, etc), particularly if the potentially lower labor costs could be realized on a mass-feeding scale. The Institutional Products Div of General Foods Corp, makers of a number of well-known coffee brands, asked its industrial design consultants, Walter Dorwin Teague Assoc, NYC, to study coffee-making methods and equipment in relation to the food service industry.

At the same time, in another part of the program, the Maxwell House Div. laboratory was asked to undertake an investigation that established the factors determining quality and acceptance of the brew from soluble coffee. Satisfying these requirements through batch after batch of coffee brewed by a variety of people at all hours, and various stages of busy-ness and fatigue, indicated a need for completely automatic equipment, something that did not exist in the food service field. And to take metering of the instant coffee out of the operator's hands required a new packaging system. In other words, the machine to be developed had to ensure complete control of the product—the soluble coffee—from the time it was packaged until the brewed coffee was poured into the customer's cup.

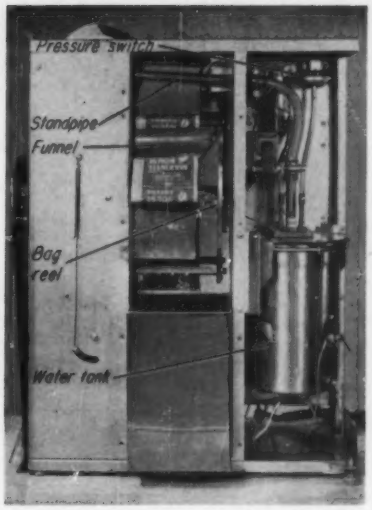
A working prototype (photo, left) of the coffee maker first demonstrated by the Teague organization around the middle of 1960 was able to satisfy all objectives.

As introduced at the National Restaurant Show in Chicago this spring, the machine is capable of making up to 300 cups of coffee (10 gal.) an hour—as compared to 180 cups for the best competitive figure. The General Foods coffee machine requires only a third of the direct

STRIP of instant coffee packages being threaded into machine's loading reel. Left side covers removed, showing elec-



trical circuitry and coffee loading unit. Right side covers removed to show water tank, temperature and level



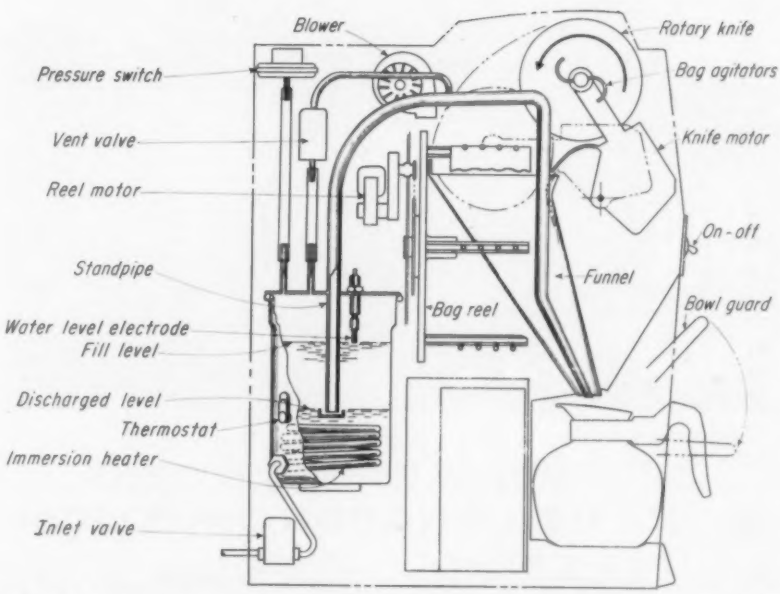
control arrangement. Machine takes up only 13 in. of counter space and is 24 in. deep, 28½ in. high.

labor time required by other machines. And since the new machine is connected directly to the water supply, it eliminates the perilous pouring of boiling hot water over ground coffee in the top of conventional coffee urns.

In fact, the General Foods equipment stands only 28.5 in. high, and its 24-in. depth makes it suitable for the backbars of even the most crowded luncheonettes. Of particular interest to the smaller food service operations is the fact that the machine is competitively priced—plus the fact that it produces the same quality of brewed coffee whether it is used to capacity or only infrequently. The on-off switch also allows using the machine to draw hot water alone for tea, cocoa or soup.

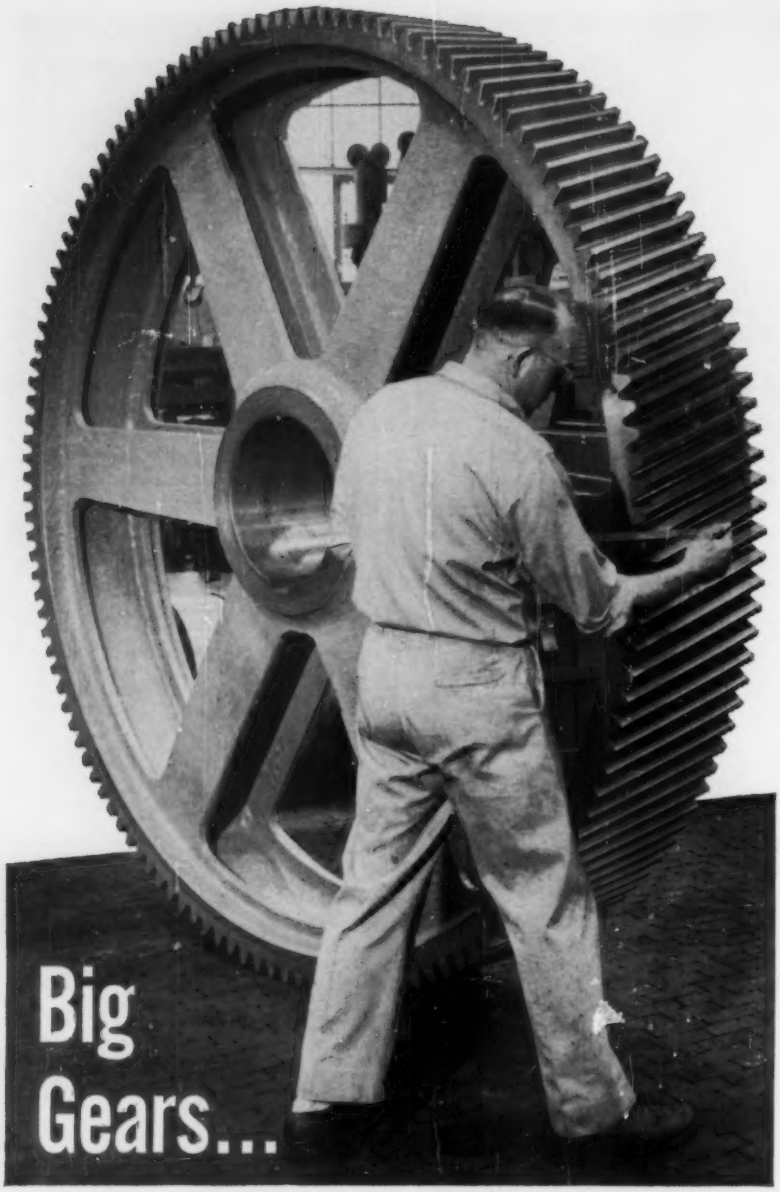
The machine is charged with a strip laminated of paper, polyethylene and aluminum foil, divided into 18 bags containing identical quantities (by weight) of instant coffee. The carton containing the strip is inserted in the brewer by the operator, who threads the strip onto the loading reel. After placing a standard glass coffee decanter in position, the operator depresses the decanter guard lever for 3 to 5 sec to begin the coffee-brewing cycle. The machine opens a package of instant coffee, empties the contents into the decanter, mixes it with boiling water. Only one adjustment is provided—because coffee strength preferences vary according to locality, the machine may be set to deliver 56, 60, or 64 oz of water to the carafe.

The brewer operates on a standard 208 or 240 v line and uses this voltage only during the brewing cycle. It is being manufactured by the Lennox Tool & Machine Builders Co. JK



Coffee is produced by placing decanter in the machine and pushing the bowl guard down. Depressing the guard energizes the immersion heater and initiates the timer cycle. The timer advances the reel to bring a new envelope under the rotary knife. The rotary knife begins to spin and while spinning pivots through approximately 50° arc to slice the polyethylene-aluminum bag in half. The agitators attached to the knife hub beat the bag to remove all of the contents. The product in the bag drops down the tinned funnel into the bowl.

When the water in the tank reaches boiling temperature the pressure switch closes the vent valve, de-energizes the water level circuit and shuts off the heater. Steam pressure then drives the water through the standpipe to the bowl. When the water level drops below the level of the standpipe the steam pressure drops, pressure switch opens vent and energizes the water level control to refill the tank. Air from blower is directed down the funnel to keep it dry at all times. This prevents the product, instant coffee, from sticking to or clogging the funnel.



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READER TO EDITOR

Author's reply to patent problem

To the Editor:

Perhaps my comments were not sufficiently clear, but Mr Tricon (June 12, p 28) has misunderstood the five-patent proposal. The requisite of five issued patents applies only to qualifying an inventor for the benefits. They need not even have been granted during work for a single firm . They merely establish proven creativity. The requisite has nothing to do with a firm's establishing or expanding its business. The benefit, derived by the inventor only when a firm does establish or expand a business on the basis of an invention of his which occurs after at least five patents have been issued to that inventor, includes the sixth and subsequent patents.

The employer would not be judge and jury if this proposal were enacted into law. However, we propose no law to eliminate job-hopping. We merely believe that engineers would be more content when reaping the benefits of their work and would choose to remain in their job. We propose no law to prevent the hiring of new talent, to prevent the buying of "outside" inventions, or encourage the stifling of business. We recognize that there are always those who seek loopholes and engage in skulduggery. We must rely on the legislative body to draft the best possible plan to achieve the goal of reward for creativity.

—Samuel R Frankel
Frankel Engineering Labs Inc
Reading, Penna

Patents! Who owns them?

To the Editor:

From the officials of large corporations and government laboratories I have been hearing how research is no longer an individual accomplishment, but is the result of a team. It naturally follows that the government has the biggest team of all. The second part of this theory of group achievement is that all the creative efforts belong to the owner of the labs because they occurred through the use of the firm's equipment and the interaction of the firm's personnel. Creativeness is not something that a man owns or possesses. It is the result of group effort.

Why don't the universities tune in on this line of thinking and stop giving individual grades? Surely they know that it is the group that takes the course, that uses the expensive equipment and comes up with the answers. Why should they bother to give ownership of the grades to individuals? The individual is just going to become part of another mob—oops! "group action"—and all the results there will be owned by the institution, for they, like his grades, will be made by group activity with the physical equipment supplied.

As a nation, are we saying, "It is immoral for Russia to own the individual's land and to continue to take this item by conquest, but it is all right for the USA to own the minds of its people and to take

all that they can produce?"

On second thought, why should the Russian own his land, or the American his creativeness? They are both happy, aren't they? —Howard R Johnson
Haddonfield, N J

Design engineers unfit for value engineering

To the Editor:

In your editorial in the June 5 issue, "He Who Has Ears," p 39, I got the impression that you associate value engineering with underdesign. This is not true in any sense and I object to the inference. Any ethical value engineer worth his salt will not sacrifice any necessary function for the sake of cost reduction.

It is not my intent to illustrate this writing with glowing examples of cost reduction without loss of function. It suffices to say we have produced our share of cost reductions and often improved design at the same time. It seems to be sort of normal for design engineers to be critical of value engineering – the contention being that the lowest cost design is part of the good designer's job. In reality, however, if this were true, value engineers would never have a project.

It's fundamental that any qualified engineer who spends full time on cost reduction can produce significant results. Many design engineers, unfortunately, are not qualified for value engineering work because of parochial and negative characteristics and an introverted personality.

—R. E. Meyers
Head, Value Engineering Branch
San Francisco Naval Shipyard

COMING EVENTS

JULY

9-14 . . . . Instrument Society of America, IFME, AIEE, IRE, 4th International Conference on Bio-Medical Electronics & 14th Conference on Electronic Techniques in Medicine & Biology, Waldorf-Astoria Hotel, NYC

18-20 . . . . Western Plant Maintenance and Engineering Conference and Show, Pan Pacific Auditorium, Los Angeles

AUGUST

23-25 . . . . American Institute of Electrical Engineers, Pacific General Meeting, Salt Lake City, Utah

28-Sep 1 . . . . American Society of Mechanical Engineers and American Institute of Chemical Engineers; Institute of Mechanical Engineers and Institution of Chemical Engineers (Great Britain), International Heat Transfer Conference, Univ of Colorado, Boulder

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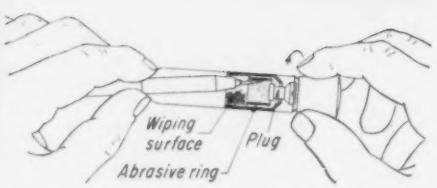
FOR YOUR INFORMATION (personal)

Be sharp, stay sharp

A pencil pointer, specifically designed for draftsmen and engineers, is being introduced by Jones & Co, PO Box 2074, South Bend, Ind.

It has an abrasive ring to do the sharpening, a vinyl-plastic wiping surface to clean the point, and a stop plug to position the pencil and keep the operating parts clean. The case is aluminum (about ⅜ in. dia), and over-all length is 3 in. Price: $1.50 each ($1 each for 10 or more).



Want to swim?—wiggle

It's oscillation of the skin, not the beating of fins and tail, that moves a fish forward. So says Office of Naval Research. It's been sponsoring studies at California Institute of Technology which are exploding a good many fish stories. The aim: new approaches to propulsion.

The studies, on live fish in the Columbia River and on a "mechanical fish" (a strip of copper foil immersed in a water tunnel and undulated by a system of cranks and gears) built at CalTech show the fins and tail function primarily as ailerons and rudders—for stabilization and control. Main propulsion is from oscillation of the body. The wiggling produces a pressure difference across the two sides of the fish. Forward thrust is achieved when the body is angled so that the side of greater pressure pushes the fish forward. Motion of the body travels in waves from the head to the tail, at a rate that exceeds the swimming speed.

As an index of this motion, Navy uses "reduced frequency," defined as length of the fish multiplied by frequency of tail beat and divided by speed of the swim. For efficient thrust, the index should be greater than one. Tests show that it is. A trout 1.5 in. long has a tail beat of 24 per sec and can swim 26.4 in. per sec. An 11-in. trout with a tail-beat frequency of 16 per sec swims 114 in. per sec, giving reduced frequencies of 1.36 and 1.55—and efficiencies in the order of 80 to 90%.

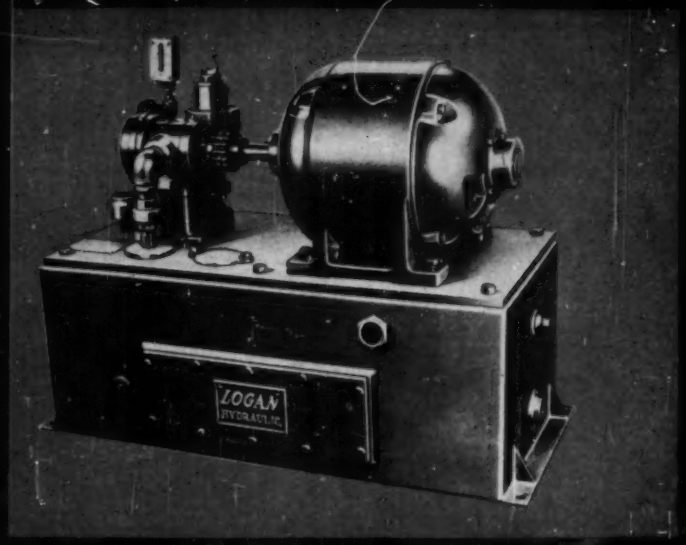
Science anyone can afford

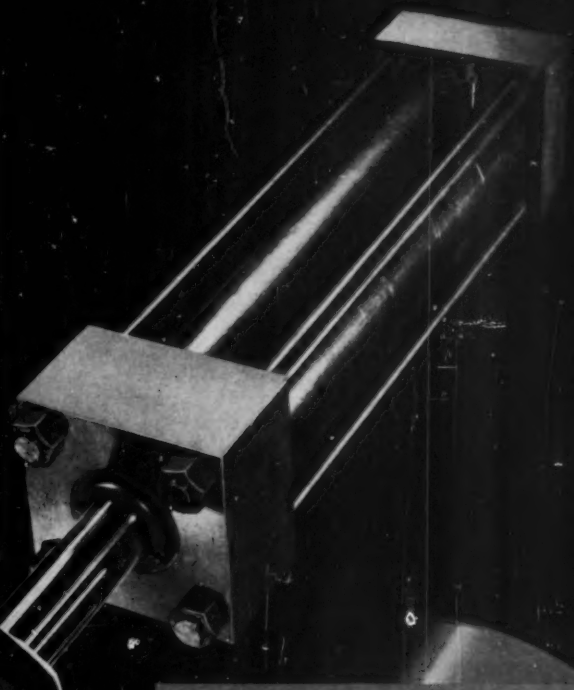
New science kits, priced at just 59¢ and $1, are being introduced by Stuart Mfg Co, 337 W 5th St, Cincinnati 2, and they contain quite a bit for the price.

In the Optical Illusions kit (see illustration), cardboard cutouts are provided to demonstrate the well-known "mystery house," "top hat," and "window" illusions, and a dozen others; also an 8-page printed instruction book. Other kits in the dollar series include Magnetic Energy, Electromagnetism, Static Electricity, Electric Currents (complete with battery, contacts, bulb, wire, and manual); and Spectroscope and Polariscope.

The 59¢ kits are stripped-down models; but still contain enough material for several experiments. The 59¢ Magnetic Power Set, for instance, has a compass, magnet, iron powder, test parts, and an instruction book. —ARG

CIRCLE 21 ON READER SERVICE CARD→





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This husky self-contained power unit combines true economy with tremendous efficiency to power cylinders, chucks, clamping devices and many other hydraulic machines.

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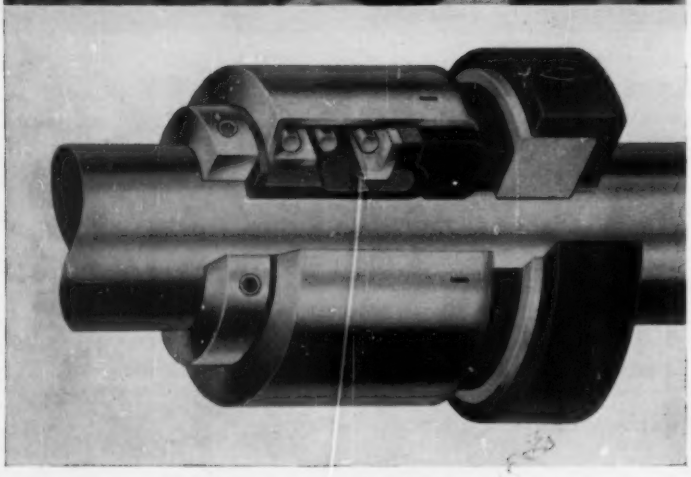

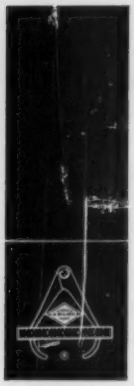

MECHANICAL SEALS in Design Engineering

Here's a sure way to maintain tight sealing under severe conditions—design with Garlock PK Mechanical Seals. Over the years, user after user has expressed complete confidence in Garlock PK MECHANIPAK Mechanical Seals. One such example is the Construction Machinery Company, a leading producer of contractor and irrigation pumps. They had a problem of maintaining an air-tight seal along the shaft of end suction and self-priming centrifugal pumps to keep the suction lift operating at maximum efficiency.

To do the job properly, Garlock PK MECHANIPAK seals were specified. Since the original installation nearly 10 years ago, the seals have done the job well at pressures to 150 p.s.i., on shafts with speeds to 3500 r.p.m., and where muddy, silt-laden water churns violently without letup. Long life, less downtime, and greater convenience are just a few of the benefits realized; Construction Machinery is particularly pleased with the easy to install, self-contained "package" construction of Garlock PK MECHANIPAK Seals.

Pass this fine performance on to your customers. Design to include Garlock PK Mechanical Seals on centrifugal pumps, automatic washers, dishwashers, gear boxes, speed reducers. The seals will perform effectively at temperatures to 212°F, pressures to 150 p.s.i., shaft speeds to 2000 f.p.m. Your local Garlock representative has complete information. Call him at the nearest of the 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-150. Garlock Inc., Palmyra, N.Y.

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Order from the complete line of quality Garlock products... Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

Garlock PK MECHANIPAK* Seals keep dirty water from motor, help maintain long suction lift by preventing air leakage on Construction Machinery Company pumps (top).

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GARLOCK

PRODUCT ENGINEERING HORIZONS

JULY 3, 1961

WAR ON WAR

Increasing concern has been expressed over the power of currently available weapons, first among engineers, then among the public, and more recently even in the Pentagon and the White House. Confidence in the newer weapons as war deterrents has been shaken by the realization that one madman's word or touch on a button might start a holocaust.

Thus far, the emphasis has been almost entirely upon building missiles so powerful they dare not be used, and scientific and engineering manpower have been mobilized for this arms race. The emphasis has been upon *deterrence*—if every country's protestations can be believed.

Now, however, scientists and engineers themselves are going beyond this concept to one of war safety control—literally war *prevention*. The effort is to prevent the crises which start wars, to prevent any nation or group from committing national suicide by threatening or waging war against other people.

The theory is that each nation will resolve its internal problems independently, with no interference from an outside nation or group, and that no deterrence will be placed on individual or national thought or action—*as long as it does not affect other nations*. It is, in effect, an enlargement of the present concept of urban living, in which the independence of the individual property owner is respected, the basic controls being upon his relationship with his neighbors.

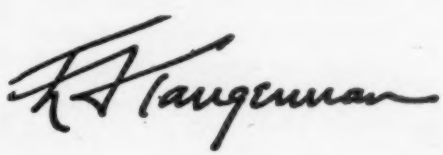
This would make the United Nations eventually an advisory and staff organization, having staff responsibility and service functions. A world-wide detection organization would be required, to keep track of nuclear materials and devices, as well as a policing force probably equipped with non-lethal weapons such as the tranquilizing gases recently hinted at. These could literally make the lion lie down with the lamb, and provide time for a war-safety control command to mobilize itself for control in the area–time–for the fire department to arrive.

Such concepts are now only visionary, but they can be realized if somebody starts them. Preliminary steps have already been taken. Some 20 scientists, engineers and executives have signed their names to a consulting report called "Control of World Crisis"* by Howard G Kurtz, submitted to the Foundation for Instrumentation Education and Research, 335 East 45th St, New York 17. Copies are available at 50 cents each, or at printing cost in quantity.

Engineers mobilized to create ever-increasing destructive power have been so successful at it that this power, if used, now would destroy the nation launching it, along with world civilization. These same engineers may now be mobilized for a far greater effort, a far more difficult task of creating the new technologies of enforceable safety discipline to make the people of all countries safe against war simultaneously.

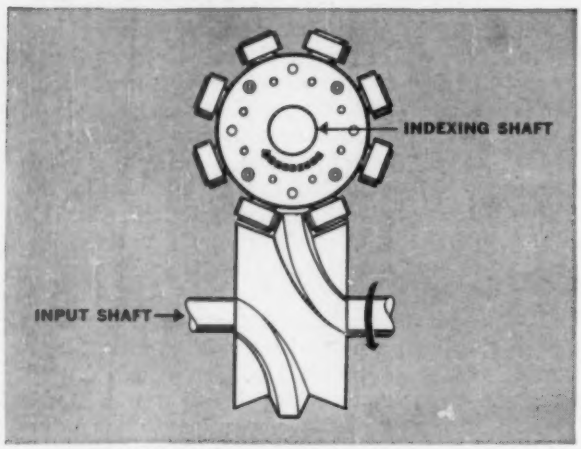
No one is asking engineers to undertake the "political" work required, but only to perfect the hardware, instrumentation, communications and mechanical safety devices required, on a world scale, to make future war impossible. Each engineer now working on destructive power may gradually find his forward march committed to the new goal of making the earth safe for human progress. He may be able to face his community and his church and his family with even greater pride in the contributions he is making to THEIR future.

***More detailed outlines of technical problems of research appear in "The Technical Problems of Arms Control," by Feld, Brennan, Frisch, Quinn and Rochlin, for the American Academy of Arts & Sciences, available for 50¢ from the Institute for International Order, 11 W 42nd St, NY 36.**



How Ferguson *ELIMINATES BACKLASH* in Index Tables

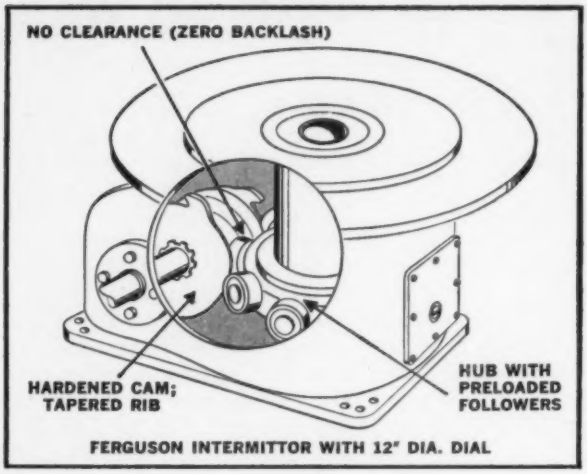
Backlash in indexing results in shock loads that affect the efficiency of a machine and the quality of its product. Most indexing mechanisms have inherent characteristics that cause backlash and poor dynamic conditions and prevent the designer from taking full advantage of modern feeds, tooling and methods that contribute to production economy.



Ferguson Intermittor Index Tables have inherent zero backlash and extreme precision which results in a rotary transfer machine base capable of operating speeds up to 500 indexes a minute. *A Ferguson index table never proves to be a limiting factor in the speed or performance of an automatic assembly machine.*

HERE'S WHY: The continuously rotating cam of a Ferguson indexing mechanism features a *tapered rib* along which two preloaded bearing followers roll, maintaining constant contact with no clearance between them and the rib. When the mechanism is in the rest, or dwell, position, a straight portion of the rib locks the followers with zero backlash and an indexing accuracy of .001". Wear on the hardened tool steel cam is infinitesimal (many have been in use for more than 25 years). Followers are rated for a minimum of 8,000 hours operation. If backlash occurs after this period the life of the drive may be renewed merely by replacing the standard followers.

NOTE HOW PRELOADED FOLLOWERS ENGAGE RIB



FERGUSON INTERMITTOR WITH 12" DIA. DIAL

Compare this with other types of indexing devices. A geneva drive, with its slotted wheel and driver, and a barrel cam with a grooved track which engages one follower at a time, must have clearance in the slot or groove to allow passage of the follower. The slightest amount of clearance causes backlash. As the slot or groove wears, the clearance becomes greater and the backlash condition worsens. At the higher, more profitable operating speeds poor dynamics cause wear on other parts of the machine. The user must choose between frequent downtime for repairs or slower speeds . . . He is the loser in either case.

FREE DESIGN DATA — Load ratings, dimensions and application and installation information about standard and stock Intermittors, Ferguson Drives and in-line machines are contained in a single 36 page catalog. Every designer should have one in his library . . . Write Ferguson—Ask for Catalog No. 160.

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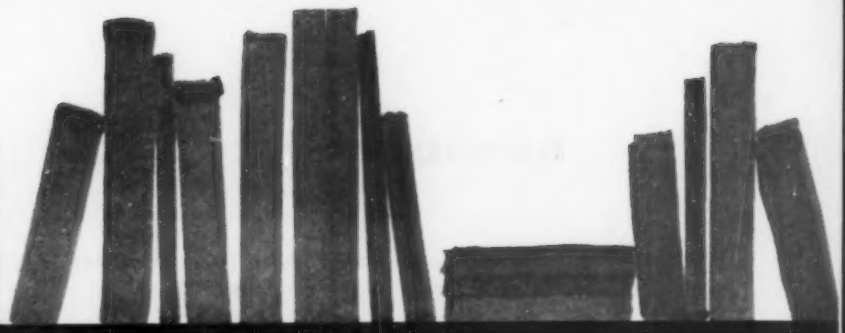

RICHARD M KOFF
Assistant managing editor

An extensive bibliography of technical books for the design engineer. Revised and expanded to include many of the newer books published since Jan 1 1959.

Over 500 selected references in 25 fields

■ **Good reference books are terse, informative, comprehensive without excessive detail; practical rather than theoretical in approach; well indexed.** The books you will find here were chosen to fit that standard.

Several thousand technical books were published in the last two years. We could not, nor would we, list them all. We are concerned here with working guides to new fields, and memory-joggers of familiar ones, rather than introductory or undergraduate texts. The subject matter has had to be severely limited to those areas of direct on-the-job importance to PRODUCT ENGINEERING readers but this is still a pretty big slice of the landscape. Book reviews, expert opinion in the various fields, and the publishers themselves assisted in the evaluation. You can help too by letting us know about your favorites—as well as the ones that weren't as useful as they might be.

Several changes have been made in this third edition. We've dropped all out-of-print books—so many excellent new ones have been published that the researcher would be wasting his time hunting up copies of older "classics."

Books on statics and dynamics have been dropped from the listing—they're usually texts associated with the undergraduate courses in those subjects. Instead, the former mechanics section has been narrowed to the more practical Mechanisms and Design.

The previously separated listings for bearings and lubrication have been combined. The two subjects are not truly separable and many good books, particularly the more recent ones, treat the lubricant as just one additional parameter of bearing design.

As with the second edition, books of tables are not included in this list. A comprehensive list of mathematical tables has been reprinted in "Shortcuts for Longhand Computation," a 64-page, 12-article combined reprint available from PRODUCT ENGINEERING at $2 a copy.

As, in all aspects of current industry, book prices are rising. Well over half the books listed two years ago have had price changes or revisions. These corrections have been made in the entries and many new books published since then have been added to the list.

Space does not permit mention of the many people whose generous contributions of time and advice made this bibliography possible. However, I would like to express my special appreciation to Jean Guasco, chief librarian, and to the staff of the McGraw-Hill Library. ■

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handbooks

American Institute of Physics. *American institute of physics handbook.* McGraw-Hill Book Co., 1957. 1535 p. $17.50.

American Society of Mechanical Engineers (ASME Handbook Series)
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indexes

Two major abstracting and indexing services are available for extensive coverage of the technical literature. *The Engineering Index,* published by Engineering Index, Inc., 29 West 39th Street, New York 18, N. Y., abstracts important articles from some 1200 periodicals and 300 books yearly in all languages. These are printed on standard library-sized cards and then mailed weekly to subscribers.

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The Industrial Arts Index published by H. W. Wilson Co., 950 University Ave., New York 52, N. Y., has been discontinued. In 1958 it was split into the *Applied Science and Technology Index,* and the *Business Periodicals Index.* The former is a subject index of 199 science, engineering and industrial publications; the latter, an index of 120 periodicals in the fields of business, finance, etc. Both are issued monthly, with frequent cumulations.

government publications

Best guide to government publications is issued by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., entitled *Monthly Catalog of U. S. Government Publications.* The month's publications are listed under the issuing agency with a title and subject index at the back of the issue. Each item includes information as to where the particular document is obtainable and price. At year's end an accumulated index to the year's publications is issued. Subscription price is $3.00 per year.

directory of publishers

Academic Press Inc., 111 Fifth Ave., New York 3.

Addison-Wesley Publishing Co., Inc., Reading, Massachusetts.

American Society of Mechanical Engineers, 29 West 39 Street, New York 18.

American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio.

American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Penna.

R. R. Bowker, 62 West 45 Street, New York 36.

Cambridge University Press, 32 E. 57 Street, New York 22.

Chilton Company Book Division, 56th and Chestnut Streets, Philadelphia 39, Penna.

Dover Publications, Inc., 180 Varick Street, New York 14.

Holt, Rinehart & Winston, Inc., 383 Madison Avenue, New York 17.

Industrial Press, 93 Worth Street, New York 13.

International Textbook Co., Scranton 9, Penna.

Interscience Publishers, Inc., 250 Fifth Avenue, New York 1.

Richard D. Irwin, Inc., 1818 Ridge Road, Homewood, Illinois.

Longmans, Green & Co., Inc., 119 West 40th Street, New York 18.

Macmillan Company, 60 Fifth Avenue, New York 11.

McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36.

Oxford University Press, 417 Fifth Avenue, New York 16.

Penton Publishing Company, 1213 West 3rd Street, Cleveland 13.

Pergamon Press, Inc., 122 East 55th Street, New York 22.

Pitman Publishing Corporation, 2 West 45th Street, New York 36.

Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Reinhold Publishing Corporation, 430 Park Avenue, New York 22.

Ronald Press Company, 15 East 26th Street, New York 10.

St. Martin's Press, Inc., 175 Fifth Avenue, New York 10.

Society of Naval Architects, 74 Trinity Place, New York 6.

Special Libraries Association, 31 East 10th Street, New York 3.

University of California Press, Berkeley 4, California.

D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, New Jersey.

John Wiley & Sons, Inc., 440 Park Avenue South, New York 16.

reprints

Copies of this report are available for 50 cents each by addressing Readers Service Dept., *Product Engineering,* 330 West 42nd St., N. Y. 36, N. Y.

A MECHANICAL BRAKING SYSTEM . . . WITH FEEDBACK AND SERVO CHARACTERISTICS

A common band brake is modified using feedback techniques to provide constant torque or constant-tension operation independent of friction coefficient.

W T SELSTED, *vice-president, engineering*
Ampex Corp
J A DINSMORE, *senior engineer*
Ampex Instrumentation Products Co
Redwood City, Calif

■ Here is a simple way to convert a band brake into a feedback braking system to give predetermined and independent amounts of braking torque for either direction of rotation. The system, now incorporated into many of the Ampex tape recorders, employs feedback principles to reduce irregularities in the braking friction.

The system can be modified to provide also a constant tension when unwinding a tape or spool. Key feature of this negative feedback braking system is that the braking torque is independent of the coefficient of friction. Thus, braking is smooth and uniform, and operation is not affected by dirt or oil, or by hot, cold, wet or dry conditions. The system is easily manufactured and assembled, and when applied to tape recorders, it is used on both supply and take-up turntables for controlled braking following fast forward or rewind operation.

Components of the brake system

The main problem encountered in mechanical braking systems is that the coefficient of friction between the drum and band is a variable. It varies with time, wear and environmental conditions. We recognized that this variation is analogous to changes in gain in an electrical amplifier, where stability of gain is achieved by use of negative feedback. Here is how this analogy resulted in the development of the mechanical braking system shown on the next page.

In our approximation the brake band wraps around the drum 300°. The band is compliant, and its shape conforms easily to the drum. The band lining can be of any suitable braking such as asbestos, cork or felt—providing the coefficient of friction is high enough to make the brake self-locking.

Springs *1* and 2 provide the braking force at opposite ends of the band. Cross-bars are attached to the brake band and come in contact with stationary stop pins depending upon direction of rotation of the drum. The brake is disengaged by means of the linkage which is actuated by means of the solenoid.

How it works

The equation which describes the operation of a band brake using a high-compliance band is:

$$T_2/T_1 = e^{\mu\beta}$$

where T_2 and T_1 are the tensions in the two ends of the brake band (the tensions are not necessarily equal to the tensions in springs *1* and 2), μ is the coefficient of friction, β is the wrap angle, and e = natural log = 2.718. In the case of a self-energizing arrangement the end of the band corresponding to T_2 would normally be firmly anchored and the tension corresponding to T_1 would be applied by spring *1*. If we assume the direction of rotation shown by A, the performance of the system can be described as shown in the above equation where T_1 would be a constant, because the tension is supplied by spring *1*. Then by differentiating:

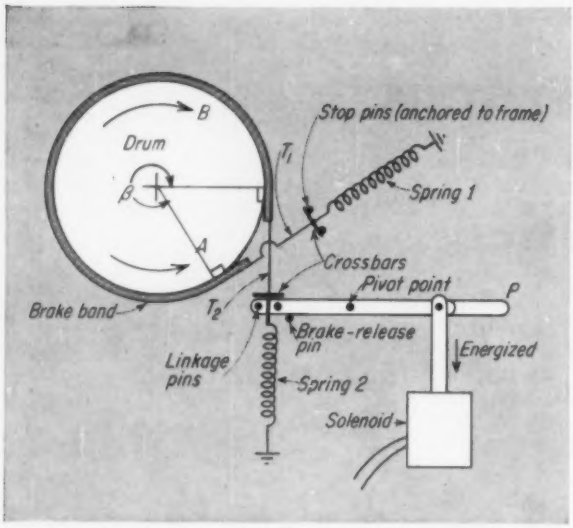
$$dT_2 = \beta\, T_1 e^{\mu\beta} d\mu$$

Thus, the value of T_2 changes with the coefficient of friction μ as an exponent of e, which shows that this arrangement is regenerative or has "positive feedback."

If, on the other hand, T_2 is held constant by anchoring the band at the end corresponding to T_1, then by applying the same equation as before and differentiating with respect to T_1 we have:

$$dT_1 = -\frac{\beta T_2\, d\mu}{e^{\mu\beta}}$$

Thus, T_1 varies with μ as an exponent of e in the de-



nominator. This arrangement is degenerative or has "negative feedback". It compensates for variations in the coefficient of friction.

Because of the arrangement of cross bars and stops at opposite ends of the brake band, the degenerative condition exists whether the drum is rotated in either dirction. Because the braking force is solely a function of tension in the spring attached to the trailing end of the band, it is possible to apply a different braking force in each of the two directions. This is desirable in the design of a tape recorder, to permit high-speed stops without throwing a loop of slack tape—even for large differences in the amount of tape on the two reels. The maximum torque in our application is the torque above which the tape would be stretched. The lower torque in the opposite direction would then be between $\frac{1}{3}$ and $\frac{1}{10}$ the maximum. Once set, the brake requires no adjustment.

For constant tension

To provide tape from a supply reel at constant tension rather than constant torque this brake system can be used as part of a mechanical servo system. All that is needed is to apply a force at point *P* on the solenoid linkage from a tension sensing guide. Tension in the tape will be proportional to the applied force. The force subtracts from the braking force applied by spring 2 which applies torque to the reel. This arrangement assumes the direction of rotation of the reel from which the tape is unwinding is as shown by the arrow marked A. Such a mechanical servo is extremely inexpensive since very little additional equipment is needed other than the brake system described. It is, of course, necessary to take normal precautions in such a servo to avoid any danger of oscillation.

EDITOR'S NOTE: For additional information on design of friction brakes:

Design of External Brakes, Nov 23 '59, p 75—Gives new equations and coefficients which simplify the usual lengthy analysis. The aim is to increase braking-torque capacity and heat dissipation.

Graphical Method for Shoe Brake Design, Mar '56, p 142—Center-of-pressure concept determines equilibrium of forces quickly and accurately. Included are six sample problems.

—Nicholas Chironis

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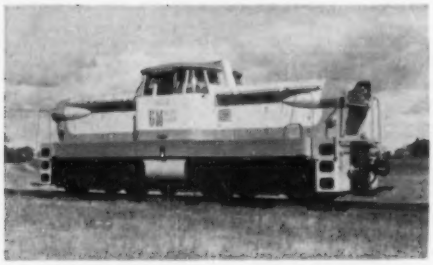
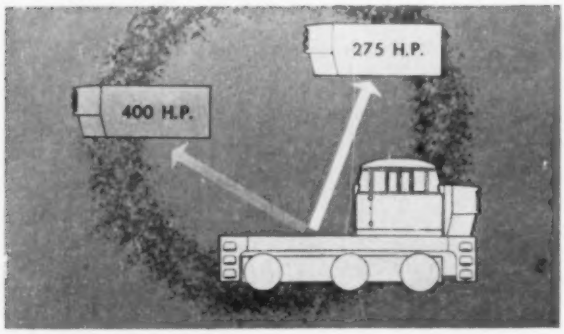
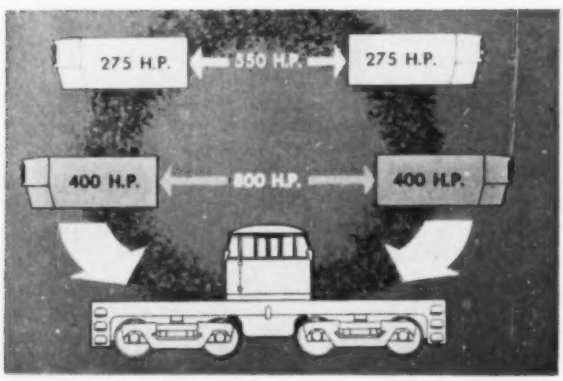


Now—a do-it-yourself locomotive

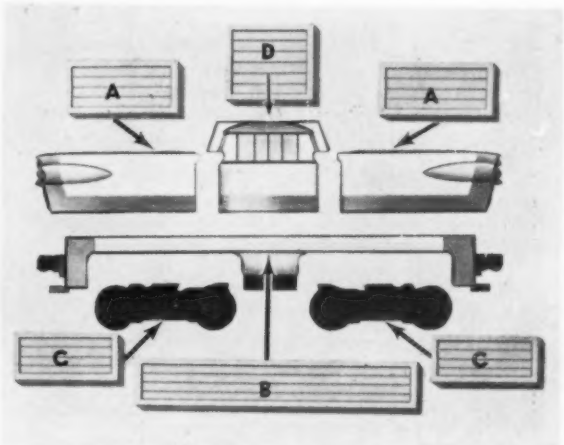
Choice of powerplant and many interchangeable components permit user to tailor locomotives to his exact needs. Unitized construction simplifies shipping and assembly.





TWO BASIC LOCOMOTIVE TYPES are produced: a double-engine, 2-truck model; and a single-engine unit with three independently suspended axles. Two diesel engines, a 275-hp V-8 and a 400-hp V-12, provide four power options. All models use the same single-stage, multiple-phase torque converter to supply a 2.5:1 torque multiplication. Interchangeable items on all models include the engine hood, cab, air compressor, cooling-system controllers, and end frames.

Subassemblies are produced that can be put together to form a complete locomotive in minimum time. This permits units to be assembled for specific customer requirements from standard components manufactured on a planned schedule for maximum plant efficiency.



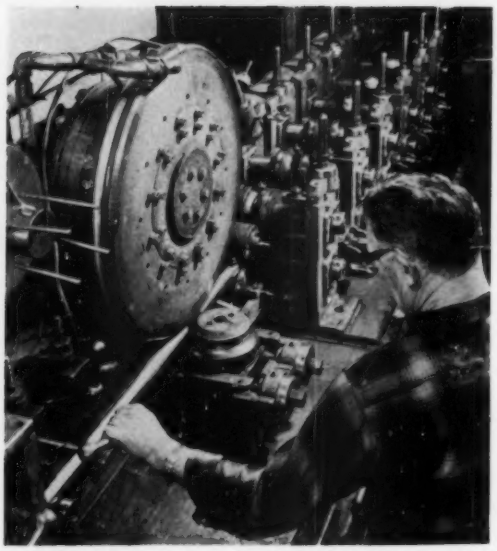
UNITIZED CONSTRUCTION permits the engine to be broken down, for crating, into powerplant, frame, trucks and cab. Powerplant assembly crate (A) contains the hood, engine, torque converter, air compressor, cooling system, air intake and exhaust system, and all necessary auxiliaries. All-welded frame (B) is crated with the air tanks and piping, fuel tanks and lines, couplers and truck mountings. The trucks (C) are fully assembled before crating and ready for attachment to the frame and gearboxes. The complete cab (D) with all controls is ready to mount on the frame as soon as the crating is removed.

PS . . . The general-purpose locomotives are for service in freight, passenger, switching, transfer or mixed traffic requiring a unit with light axle loading. Two diesel engines provide power range from 295 to 800 hp with single locomotives, or up to 2400 hp when operating as multiple units with three locomotives hooked together. Due to the dollar shortage in many countries, a flexible policy has been adopted to permit local manufacture of these units. It permits local manufacturers to start assembly rapidly and in successive stages fabricate more and more of the locomotive until only the engine, transmissions, gear boxes and controllers are purchased. Locomotive models GMD H-3 and GMD H-1 are produced by General Motors Diesel Ltd, London, Ontario, Canada.

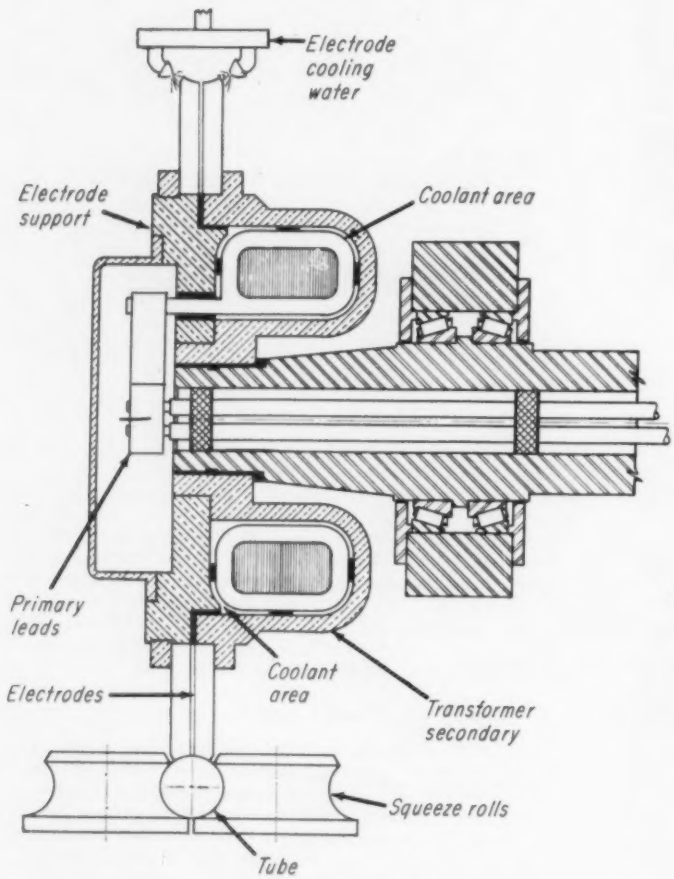
—JJK

Transformer becomes part of welding head

Toroidal-transformer core is built into this welder head to eliminate secondary conductors. Vapor coolant is a dielectric fluid that simplifies insulation and piping.



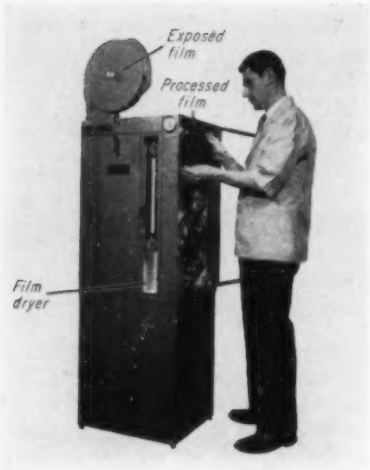
WELDED TUBING is produced from flat strip stock. Coiled strip is passed through a series of rolls to form a tube with an open seam. A wheel-type electrode closes the seam as it passes the welding station. Squeeze rolls hold the tube in position during the butt-seam welding operation. The resistance welding is accomplished by short-circuiting the secondary of a low-voltage transformer with the edges of the tube to be welded. This draws a very high current through the open seam, producing sufficient heat to forge the edges. Resulting weld strength equals strength of the parent metal.



TOROIDAL-SHAPE TRANSFORMER is mounted inside a one-piece electrode support which acts as single-turn secondary. This support has the multiple functions of containing the dielectric coolant, supporting both transformer primary and electrode, and also providing a protective housing for the primary. Electrical connections to the primary pass through the hollow support shaft.

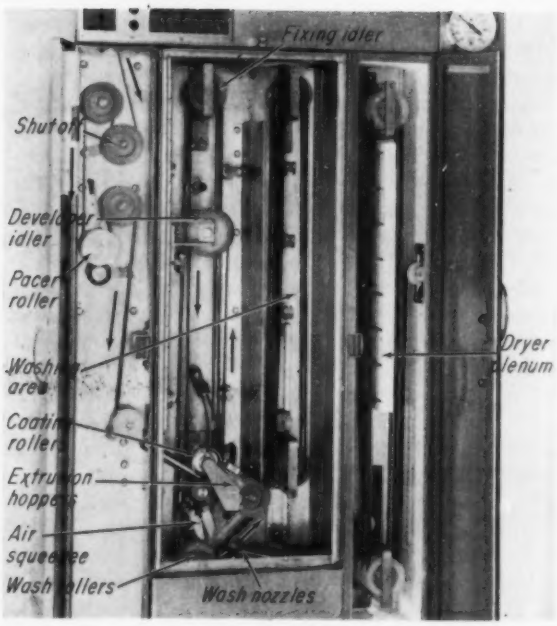
Transformer cooling fluid is a dielectric, non-toxic fluorocarbon which eliminates need for a secondary conductor system. The transformer secondary is directly connected to the electrode to provide the shortest possible electrical path. This reduces secondary impedance and permits current to be transmitted directly to the electrode. Fluid in the sealed coolant area lowers temperature of transformer primary and its core by vaporization. This vapor is converted back to liquid upon contact with the transformer secondary which encloses the primary. Heat from the transformer secondary is removed by external water used to cool the electrodes.

PS . . . The 125-kva resistance welder shown produces auto exhaust pipe at the rate of 106 fpm for 2-in. tube. 0.075 in. thick. Other units being built or planned will handle pipe up to 9/16 in. thick and 42 in. dia, using a 5000-kva welding head. Type-V resistance welder is produced by The Yoder Co, Cleveland.—JJK

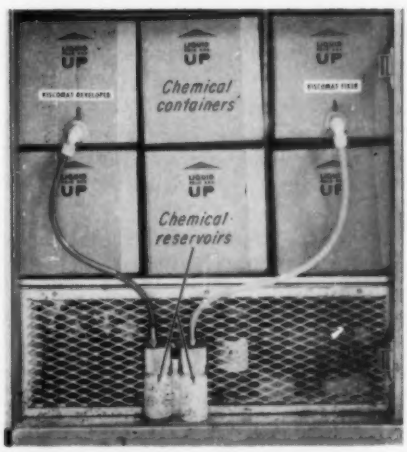


Extruded developer speeds film processing

The saturated processing chamber wets and preheats the exposed film. Then it's coated—by extruders—with viscous chemicals that do the developing.



EXPOSED FILM FIRST passes around a shutoff roller which will stop the development sequence if film tension is broken. Film then passes over an idler and to the pacer roller. From here it's fed at 36 fpm into vapor-filled processing chamber where it passes over the coating roller and where an 0.008-in.-thick coat of developer is extruded from the extrusion hoppers onto the film surface. The coated film next passes upward, around the adjustable developer roller and then down to wash rollers at base of the cabinet. The development idler is vertically adjustable to provide the variable development time required for different films. After the high-velocity wash nozzles, the film passes upward through the air squeegee, and over the inner coating roller where a coat of fixer is extruded. Film now makes a double pass over the idlers. From the processing compartment film runs under an idler to the wash area, and passes through an air squeegee to the dry area. Filtered, compressed air in the plenum-type dryer can be heated to temperatures between 90 and 150 F.



VISCOUS CHEMICALS do the developing and fixing. They are supplied in 1-gal. corrugated boxes containing sealed, flexible, polyethylene bags. When a container runs dry, a timer alarm rings. The operator removes the puncture-probe from the empty container and forces it, at the indicated location, into the new container. As the chemical is drawn off by the metering pump, air pressure collapses the plastic liner, forcing the chemicals into the processor. Any air seeping into the line during the change is filtered out in the chemical reservoirs before being pumped to the extrusion hoppers.

Chemicals are washed down the drain within seconds after application. Only fresh chemicals are used and contamination problems are minimized. Operation is simplified because all need for chemical mixing and replenishment is eliminated.

PS . . . High-speed 16mm film processor is approximately the size of a 4-drawer file cabinet and rolls on casters. Operating on 110-v 60-cycle ac, it needs only two hose connections for plumbing: one for 130-F water at 1 gpm, the other for drainage. Unit processes up to 1200-ft reels of exposed film at 36 fpm. The Viscomat processor is sold by Motion Picture Film Dept, Eastman Kodak Co, Rochester, NY.—JJK

The 3 Illnesses of Today's R & D

Three important problems face us: the general public has been oversold, researchers are more concerned with having money than in solving problems, engineers are not making best use of the results that are available.

Dr JESS H DAVIS, *president*
Stevens Institute of Technology

Taken from an address at the symposium on *"Research and the Community"* sponsored by the NY State Advisory Council for the Advancement of Industrial R & D at Sterling Forest, NY, on May 1.

■ There is a danger that research has been oversold to a general public woefully lacking in scientific, mathematical and engineering knowledge. My friends in the investment community tell me that the stock of a company with a proven research reputation will often sell at a price computed at 50 or more times its earnings, compared to 15 or so for a straight manufacturing operation with little or no research activity.

I do not think we have gotten across the picture of research in proper proportion. People feel that research can do anything—that all you have to do is "research" something and the problem is solved. This, of course, is not true. Nobel Prize winner Polykarp Kusch (atomic physics) makes this statement:

> To assume science can find a technical solution to all problems is the road to disaster. For example, not all the power of science can in the long run feed an ever-expanding population. The assumption that it can do so is dangerous. Science in itself is not the source of ethical standards, the moral insight, the wisdom that is needed to make value-judgments.

We must be very careful therefore in endeavoring to make the public at large research-conscious just so the research needs of the country get full governmental, corporate, institutional and individual support.

We must also get across the fact that time cannot always be bought by dollars. Loss of faith through misunderstanding of research could have disastrous effects.

Another problem is what appears to me to be a lack of professionalism in some of today's research. At times this might almost be called "intellectual boondoggling." It results from a number of causes, but the two most important are lack of professional researchers and lack of proper direction or leadership. It leads to a sterility of discovery, a pedestrian "playing it safe," the attempt to justify an appropriation rather than to risk a failure. Where there is no risk there can be no heights of achievement. In other words, we have here a type of policy-making that is most effective in hampering new developments—exploring only areas where it seems there will be an immediate payoff—administering the research function as if it were comparable to the more precise activities of an accounting department. I am seriously concerned about the frequency with which a young, apparently gifted and certainly inspired scientist perverts his ideas because he cannot obtain support for his real interest.

Research administrators must have the courage and foresight to invest in ideas and areas that are not and cannot be specific—that may not result in new products or services. They must, however, also have the capability in the form of a professional staff.

And this leads me to another most important problem, that of professional manpower. There is already a scarcity of able people in almost every area and because of the increasing sophistication of research and development, many presently adequate participants will lose their effectiveness after a few years unless they have the inclination, the ability and the time to keep up. We need more funds, facilities and faculty to be able to handle more graduate students and to keep educational programs ahead of the times.

Too often, the education of the engineer has not been of the type that provided him with the background necessary to understand either the many basic research findings or their significance. I believe this is now being remedied and I would hazard a guess that today, the graduating engineer from any first-rate institution is better prepared than the engineer of twenty years ago with two years of graduate work.

The development aspects of research, the adaptation and use of basic knowledge in all fields for the use of man, seems to me to be of primary importance today. Where basic research has been part of a specific program, the time lag between discovery and use has been relatively short, but where it has not, there is generally a far greater lag. We could speed up our industrial and economic progress if this time lag could be cut. I think it can be done by systematic studies of basic research results for possible and feasible development applications. Such studies would have to be carried out by the most creative type of engineers and scientists. You might call this research on the findings of research. ■

Dr Davis is a graduate engineer (Ohio State) who first worked for Atmospheric Nitrogen Corp but soon switched to teaching at Clarkson, Potsdam, NY. Starting there as assistant professor in 1929 he progressed to president of the college in 1948. He has been president of Stevens since 1951. Dr Davis has been an engineering consultant, commissioner of the Port of NY Authority, and active member of ASME and ASEE. He is a registered professional engineer.

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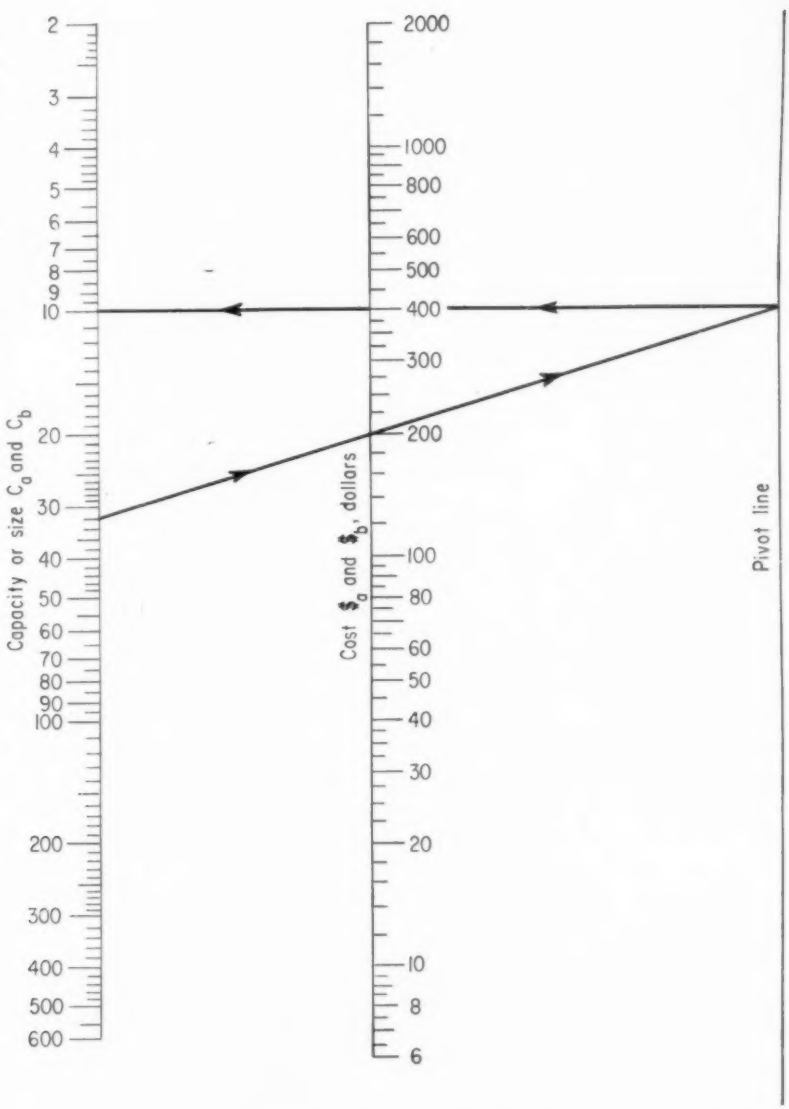
Example: How much will a 318-gpm pump cost if one with 100-gpm capacity costs $20,000? Draw two lines, as shown on the nomograph, to find the answer: $40,000.



equations the handbooks don't have . . . FOR SOLVING ARCS AND OVALS

The author had to work out these equations for himself. Now he passes them on to you.

WILLIAM L OLSASKY
Senior engineer
Norair Div, Northrop Corp
Hawthorne, Calif

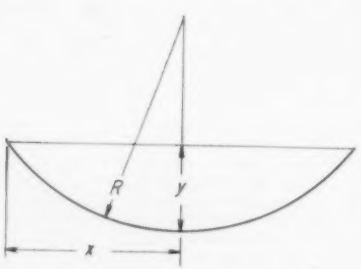
FOR CIRCULAR ARC

To find the radius when only x and y are known or can be measured, use this equation:

$$R = \frac{x^2 + y^2}{2y}$$

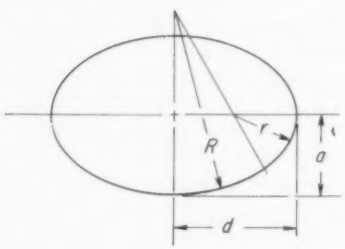
SYMBOLS

R = Radius of curvature of arc, in.
x = Half the length of the chord, in.
y = Height of arc from chord measured along the radius, in.



SYMBOLS

a = Half the length of the short axis, in.
d = Half the length of the long axis, in.
R = Radius of long side, in.
r = Radius of small end, in.



FOR OVALS

These equations:

$$r = \frac{a^2 - 2aR + d^2}{2(d - R)}$$

$$R = \frac{a^2 - 2rd + d^2}{2(a - r)}$$

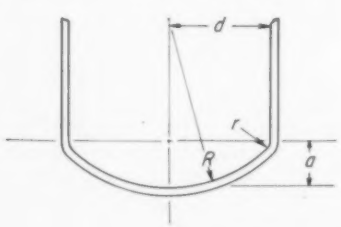
$$d = r + (r^2 - 2Rr + 2Ra - a^2)^{1/2}$$

$$a = R - (R^2 - 2Rr + 2dr - d^2)^{1/2}$$

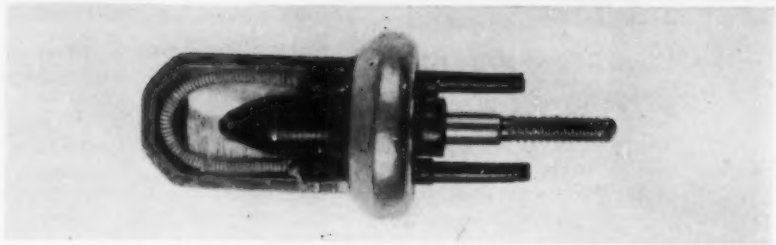
Example: In cross-section the spherically dished head on an ASME pressure vessel is a narrow oval. If knuckle radius $r = 2.10$, crown radius $R = 35$, and cylinder radius $d = 25$, what is depth of the head a?

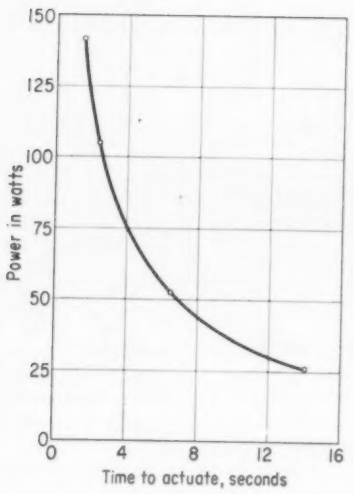
Solution: Substitute values in the equation for half the length of the short axis of an oval

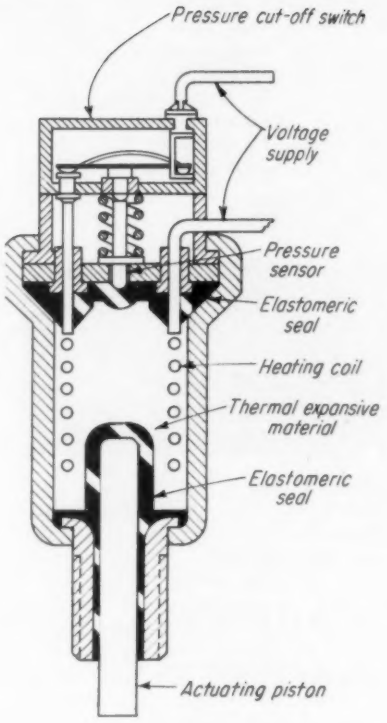
$$\begin{aligned} a &= R - (R^2 - 2Rr + 2dr - d^2)^{1/2} \\ &= 35 - [35^2 - (2 \times 35 \times 2.10) + (2 \times 25 \times 2.10) - 25^2]^{1/2} \\ &= 35 - 558^{1/2} = 35 - 23.6 = 11.4 \text{ in.} \end{aligned}$$



SIGNIFICANT COMPONENTS MATERIALS, PROCESSES



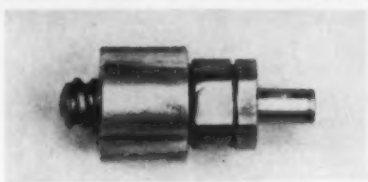




Electrothermal actuator . . .

can be coupled with mechanisms and linkages to produce (1) linear motion of actuator piston; (2) rotary motion converted from linear motion of piston; (3) 2-position operation, linear or rotary, which produces on-off, forward-reverse mechanical motion; (4) positioning operation which provides motion proportional to position of remote control device; and (5) latching operation. Unit's design also provides an inherent means of providing a time delay function. Replaces large electromagnetic assemblies in applications which require non-instantaneous operation (at price said to be substantially lower than unit it replaces) and produces forces from 30 to 200 lb, with strokes from $\frac{1}{8}$ to 6 in. or greater. Heart of actuator is a compact device which moves a piston when unit is subjected to temp rise. Source of heat applied to unit is from an integral electric resistance heater immersed in fluid or wax within body of actuator (Heater watts determine response speed. See curve based on actuator with 0.200-in. stroke against 30-lb load). Pressure developed within unit as result of thermal expansion of fluid or wax is transmitted as a force to piston through a synthetic elastomeric seal. Built-in heat source reportedly results in extremely fast response and contributes to unit's compactness. Complete device—heater, thermal element and integral heater-interrupting switch—occupies space equivalent to that required by thermal element alone on other units. Sample quantities available within 1 wk. **Standard-Thomson Corp, Waltham, Mass.**

Circle 300 on Reader Service Card



Small-diameter nut . . .

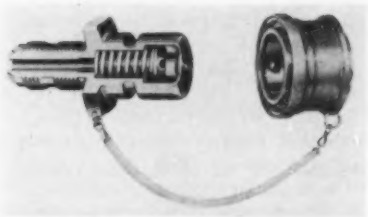
for ball-bearing screw assemblies, has integral raceway that eliminates usual exterior ball guide, reducing OD from 0.500 to 0.400 in. Assembly has $\frac{3}{16}$-in. ball circle dia and is fitted with balls 1 millimeter in dia. Delivery in 6 to 14 wk. **Actuator Operation, Saginaw Steering Gear Div, General Motors Corp, Saginaw, Mich.**

Circle 301 on Reader Service Card

Two-part epoxy adhesive . . .

bonds aluminum to aluminum with tensile shear strength of 5700 psi at 77 F (steel-to-steel bond shows 6500-psi tensile shear strength at that temp; copper-to-copper bond, 2700 psi). In addition to aluminum, steel and copper, adhesive is recommended for ceramics, glass and combinations of the materials. Retains adhesion over range from −65 to 225 F and after 30-day immersion in water. Cures in 1 hr at 300 F. Sample package, containing 1 qt base and 1 pt hardner, is priced at $8. **Conap Inc, 184 E Union St, Allegany, NY.**

Circle 302 on Reader Service Card



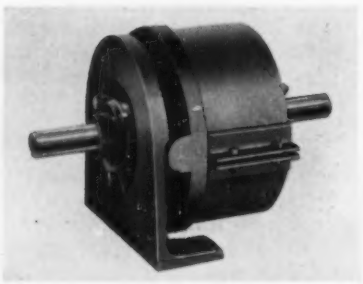
Pressure adapter and cap assembly . . .

is leakproof, quick-disconnect, all-stainless steel unit for oil servicing. When cap assembly is removed, a nozzle connection can be attached to adapter to depress poppet valve and permit oil flow under pressure. When nozzle is removed by quick-disconnect, a spring immediately returns valve to closed position, shutting off oil flow and preventing leakage. Re-

continued on page 50

portedly does not leak more than 4 cc per min. under 5 psig back pressure, using MIL-0-7808 synthetic engine oil after being exposed to a 2000-F open flame for 5 min. Body of adapter is one-piece housing spun over poppet valve and spring. Rubber O-ring is seated at end of poppet for positive seal against leakage. Groove running around body provides quick-disconnect seat for retaining balls in cap, which are cammed into locked position by outer sleeve of cap assembly. Pressure drop at 1-gpm flow with MIL-0-7808 synthetic engine oil at −45 F is 14 psig for ¼-in. tube size and 7 psig for ¾-in. tube size. **Dumont Engineering Co, 1401 Freeman Ave, Long Beach, Calif.**

Circle 303 on Reader Service Card



Disk brake . . .

is floor-mounted, through-shaft brake with own ball bearing-mounted shaft. Designed for applications where it is necessary to drive through brake, unit eliminates or minimizes alignment problems. Ac-operated and available in torque ratings of 1½, 3, 6, 9, 10 and 15 lb-ft. **Stearns Electric Corp, 120 N Broadway, Milwaukee 2.**

Circle 304 on Reader Service Card

Linear polyolefin resins . . .

include three grades for injection molding and extrusion; two for blow-molding containers; and three general-purpose grades suitable for both blow molding and extrusion. Of the injection-molding and extrusion grades, R600 is recommended for applications which require combination of moldability and toughness; R800 is recommended when mold fill is a problem, rigidity is desirable warpage must be held to a min and impact strength is not a prime requisite; and R810 (a polyolefin copolymer), for applications requiring good load bearing properties over an extended time period. Of the blow molding grades, R211 is a copolymer characterized by top resistance to stress cracking and good rigidity and R401 is an ethylene homopolymer recommended for applications where top modulus and impact strength are needed more than stress crack resistance. Of the blow molding and extrusion grades, R200 and R300 are ethylene homopolymers recommended for rigid containers, while R210 is a copolymer suitable for applications where high stress crack resistance and good impact strength are needed, as well as for creep rupture resistant monofilaments. R200, R210 and R211 (in natural color) are priced at 35¢ per lb in truckload quantities; other 5 formulations, 32¢ per lb. **Dow Chemical Co. Midland, Mich.**

Circle 305 on Reader Service Card

Polycarbonate resin . . .

is available in nearly water-clear grade for lenses, light covers, diffusers and other applications requring clarity. Said to have same physical, electrical and chemical properties as other grades in the resin line. Use of additives masks resin's natural light amber color and prevents darkening during molding. Priced at $1.30 per lb in truckload lots. **Chemical Materials Dept, General Electric Co, Pittsfield, Mass.**

Circle 306 on Reader Service Card

Welded roll . . .

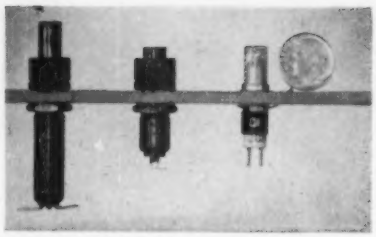
reduces tolerance requirements during manufacture, thereby reducing costs. Inexpensively fabricated component parts are assembled by welding; then, an over-all finishing operation brings roll into tolerance. Runout of roll face relative to studs is held to 0.031 in. per 6-ft length. Shaft strength is said to be more than adequate for tubular roll loadings and welded ends permit significant materials saving over forged or cast construction. Available in steel, brass and aluminum and in diameters to 18 in. and lengths to 18 ft. **New Hudson Corp, Conveyor Roller Div, New Hudson, Mich.**

Circle 307 on Reader Service Card

Rotary connector . . .

is non-separable unit which can be used for continuous rotation in either direction up to 1000 rpm or for oscillatory motion. Construction is 4 wire, 3 phase with max rating of 10 amp at 250 v. Standard equipment includes silver graphite brushes, silver plated slip rings, and clamps for any type of conduit or cable up to 1.19 in. OD. Priced at $34.75. **Frankel Engineering Laboratories Inc, Reading, Penna.**

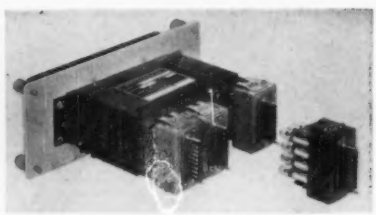
Circle 308 on Reader Service Card



Miniature indicator light . . .

consists of a replaceable lamp cartridge and mating lampholder, which mounts in a ⅜-in.-dia hole and has black anodized aluminum case, nylon insulation and solder lugs to be used as common terminal for several wires. One version is available with built-in resistor for use with neon lamps. Cartridge, which has nylon shell and stainless steel pins, can be used with lampholder or mounted directly in a $\frac{3}{32}$-in. dia hole with a spring-steel clip. Incorporates either neon or incandescent lamps for a wide range of voltages and can be supplied with imprinted lenses in variety of colors. **Industrial Devices Inc, Edgewater, NJ.**

Circle 309 on Reader Service Card



Digital readout assembly . . .

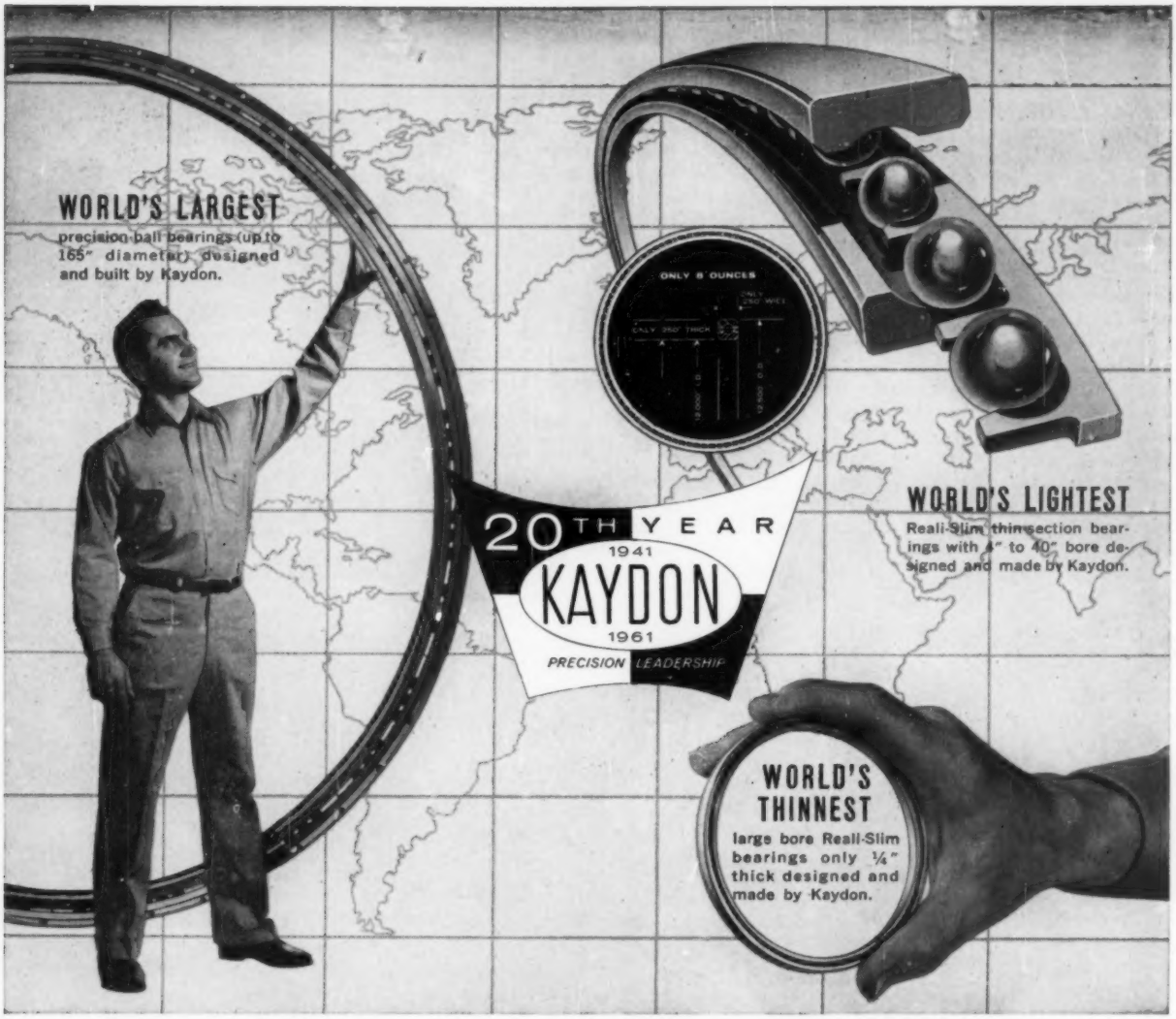
consisting of four plug-in, quick-disconnect units, can be serviced from either front or rear. Entire assembly, which is sub-panel mounted, can be removed from master panel by loosening four large captive thumb screws, allowing lamps to be serviced without disturbing internal wiring of equipment in which assembly is being used. Where rear access is convenient, lamp and terminal assembly can be quickly disconnected from rear of assembly and lamps changed. Covered wiring can be potted to specifications. Assembly measures $2\frac{5}{8}$ x $6\frac{3}{32}$ x $7\frac{1}{4}$ in. **Industrial Electronic Engineers Inc, North Hollywood, Calif.**

Circle 310 on Reader Service Card

Filament-wound parts . . .

of reinforced plastic are said to be stronger than steel and lighter than aluminum parts. Available in straight tubes, closed-end pressure vessels and in tapered or other geometrical shapes. In producing the parts, a continuous strand of very fine glass filaments is immersed in a resin

continued on page 52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precision ball bearings (up to 165" diameter) designed and built by Kaydon.
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20TH YEAR
1941
KAYDON
1961
PRECISION LEADERSHIP
WORLD'S LIGHTEST
Reali-Slim thin-section bearings with 4" to 40" bore designed and made by Kaydon.
WORLD'S THINNEST
large bore Reali-Slim bearings only ¼" thick designed and made by Kaydon.

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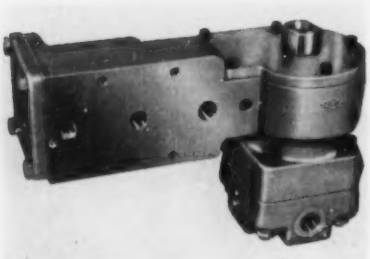
World's highest capacity, lowest cost needle bearings (22 sizes available).

bonding agent. Resin-coated filaments then are wrapped around a revolving mandrel according to a pattern which orients the filament in such a way as to best absorb stresses (bonding agent distributes stresses between continuous strands of filaments). After curing the resin, the mandrel is removed. Resulting material is reported to have excellent corrosion resistance and dielectric strength. Specific gravity is 2.2, compared with 7.3 for steel. In direction of the filaments, strength of filament-wound laminated plastic is 200,000 psi. Also said to have excellent electrical insulating properties, and once formed and cured, parts can be machined and finished. **Taylor Fibre Co, Norristown, Penna.**

Circle 311 on Reader Service Card



Air/oil valve actuator . . .

can be operated by regular shop-air pressure (usually 100 to 125 psi) or hydraulic pressure. A min of 70 psi is required. Unit is nose-mounted to 6000-psi valve for positive action. Cylinder is 3 position, operating 45° on each side of center, in any combination of 45° and 90° movements. Max working pressure is 500 psi. Can be mounted at factory, or in field, to valve with 90° handle turn, up to 1 in. size. **Republic Mfg Co, 15655 Brookpark Rd, Cleveland 35.**

Circle 312 on Reader Service Card

Polyethylene tubing . . .

made of high molecular weight, low melt index resin, is said to have highest stress-cracking resistance of any polyethylene. Remained unaffected for more than two years when subjected to ASTM stress corrosion test. During manufacture, tubing is pressure-tested at 140 lb for 15 min. Available in ¼-, ⅜- and ½-in. OD sizes. From stock: ¼-in. OD with 0.040-in. wall and ⅜-in. OD with 0.062-in. wall in red, blue, green, black, orange, yellow, purple and natural. The ½-in. OD size is supplied in black and natural only. **Synflex Products Div, Samuel Moore & Co, Mantua, Ohio.**

Circle 313 on Reader Service Card

All-steel pillow block . . .

for heavy loads and impact, is equipped with a spherical roller bearing and available for shafts from 1 7/16 to 9 7/16 in. inclusive. Rotating, labyrinth triple seals protect bearing from foreign matter while retaining lubricant. Elongated bolt holes permit easy horizontal alignment. Oil or grease can be applied directly to rolling elements through a groove in OD of bearing's outer ring or to bearing from a point near its face. Circulating oil systems can be installed, or cooling coils can be adapted. **SKF Industries Inc, Front St & Erie Ave, Philadelphia 32.**

Circle 314 on Reader Service Card

250-psi cylinders . . .

have nylon and Delrin bearings said to prevent scoring and prolong wall and piston rod life. Barrels are made of chrome-plated steel, roller-burnished to a 4-microin. finish for max sealing power and min friction. Heads are made of high-tensile-strength aluminum while piston rods are made of heat-treated, 125,000-psi yield strength stainless steel, ground and burnished to a 2-microin. finish. Self-adjusting block "vee"-design piston and rod packings automatically compensate for pressure variations with negligible breakout friction. Cushion arrangement (with cadmium-plated spring, spherical radius seal and chamfered seat) is said to assure positive cushioning with immediate acceleration on return stroke. From stock. **Alkon Products Corp, 200 Central Ave, Hawthorne, NJ.**

Circle 315 on Reader Service Card

Packless globe valves . . .

are hermetically sealed with zero leakage to atmosphere; permit instantaneous changes in setting; have high seating force and low operating torque with resulting tight seal; and are designed for high operating temps, with 600 F at 2200 psi the normal rating for pressurized water reactor service. Incorporating thermal barriers in basic design extends temp range. Based upon "harmonic drive" principle, units are available in ½ to 2-in. sizes. Other types and sizes, including special ball, plug, cock and sliding gate models, can be supplied on request. **Harmonic Drive Div, United Shoe Machinery Corp, Balch St, Beverly, Mass.**

Circle 316 on Reader Service Card

High-pressure checkvalve . . .

is miniature, stainless steel unit handling pressures up to 20,000 psig and suitable for use with corrosive fluids or hot exhaust gases up to 1800 F. Capacity is based

upon equivalent sharp edge orifice of 0.125 in. Available with fast-acting metal or plastic-coated poppets. Standard ports are for connection with ¼-in. tubing or hose, while fittings for ultra-high pressures are available. Over-all length, including fittings, is 2⅛ x 1 in. dia and weight is 0.125 lb. **Marotta Valve Corp, Boonton, NJ.**

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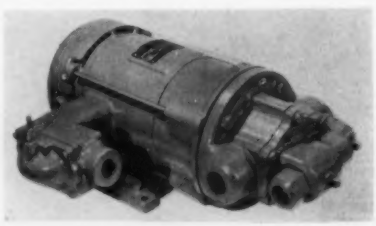


Motor-mounted rotary pumps . . .

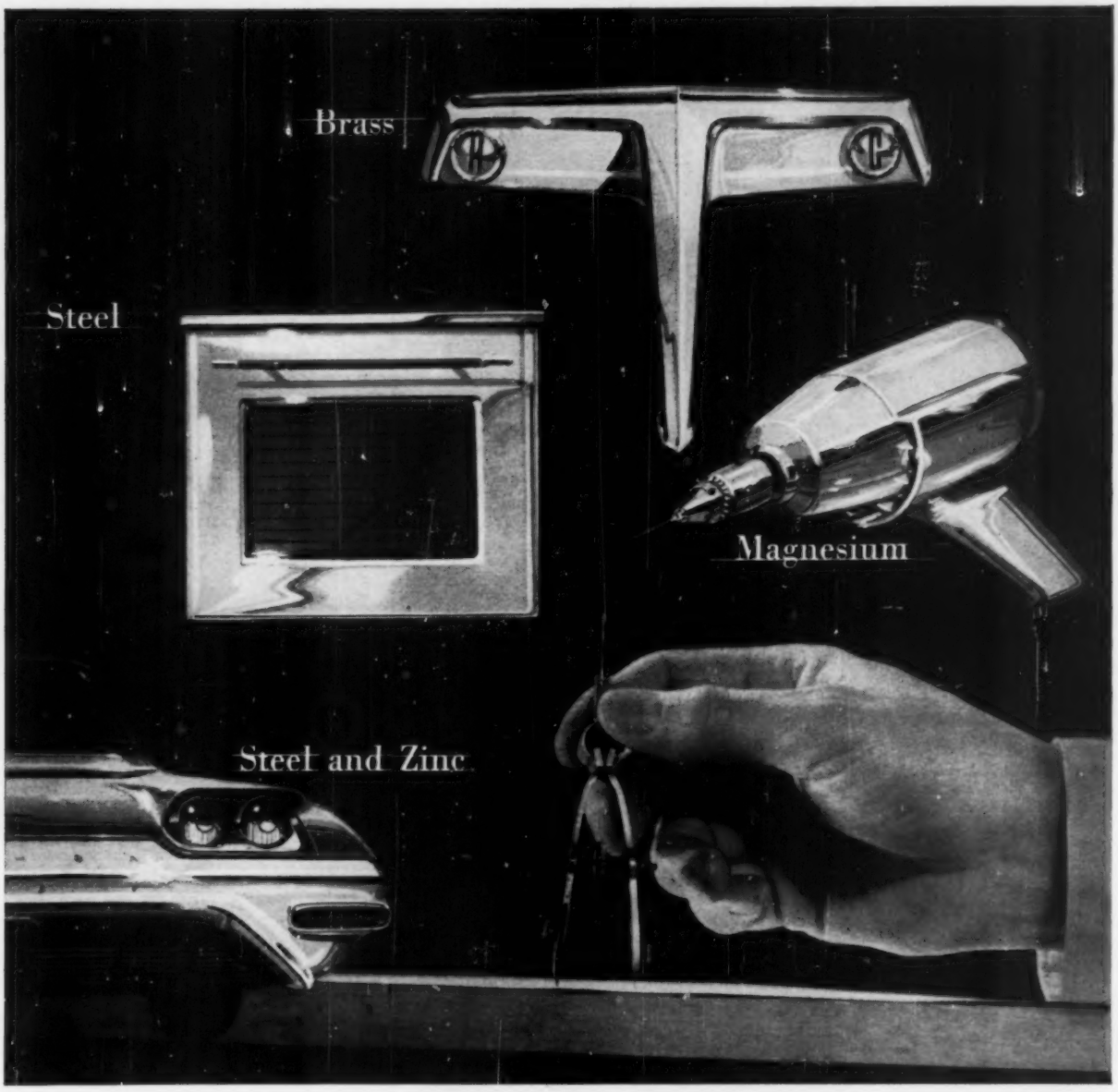
for handling clean liquids and solvents (up to 5000 ssu) deliver from 10 to 30 gpm at pressures up to 125 psi. Pump and motor are built as integral unit with common heavy-duty shaft supported by motor bearings. Requires no separate pump bearings or second seal, coupling, pump head or mounting base. Each pump is equipped with built-in relief valve to bypass delivery in case of excessive pressures. Available in 1-, 1¼- and 1½-in. sizes with choice of five different motors, ranging from ¾ to 3 hp. **Blackmer Pump Co, Grand Rapids, Mich.**

Circle 318 on Reader Service Card

Surge suppressor . . .

provides overvoltage protection for silicon and germanium cells, controlled rectifier cells and similar devices. Because of its Zener-type v-amp characteristic, unit provides a shunt path for transient overvoltages and imposes a ceiling above which surge voltage cannot rise. This permits use of silicon cells without subjecting them to overvoltage, providing cells have a peak-voltage rating above clamping voltage of the surge suppressor. Available as polarized and nonpolarized units, multiple assemblies of both types and special units, with ratings of 2 to 85 amp max dis-

continued on page 54



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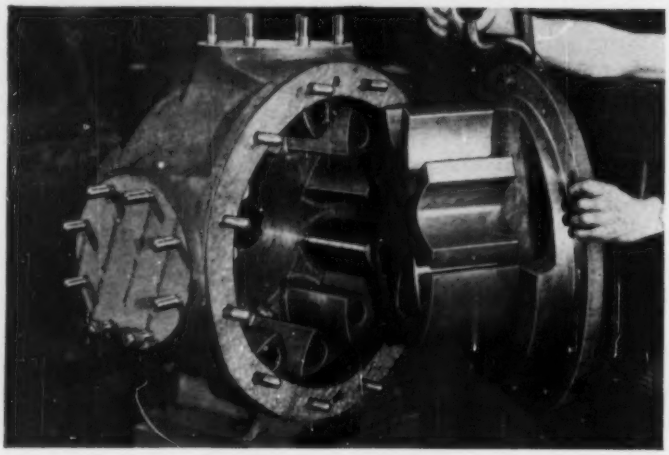

THE VIKING "GEAR-WITHIN-A-GEAR" PUMPING PRINCIPLE helps engineers solve a wide range of pumping problems throughout the world. In the petroleum industry, chemical processing, food processing, meat packing, road building and many other industries, **VIKING PUMPS** handle liquids and semi-solids efficiently and at low cost. And **VIKINGS** pump liquids ranging from thin, liquefied gas to thick, viscous tars. Originated 50 years ago, the **VIKING** pumping principle has been adapted so successfully to so many applications that **VIKING** is now the largest exclusive rotary pump manufacturer in the world.

You men who specify and buy rotary pumps, can select from a complete size range of **VIKING PUMPS**, from ½ to 1050 G.P.M. in over 850 catalogued models and thousands of special designs. If you have a pumping problem, tell us . . . and ask for catalog 61SX.

VIKING PUMP COMPANY, Cedar Falls, Iowa, U.S.A. In Canada, it's **"Roto-King"** Pumps. See Our Catalog in Sweet's Product Design File.

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Complete specifications on all parts and materials

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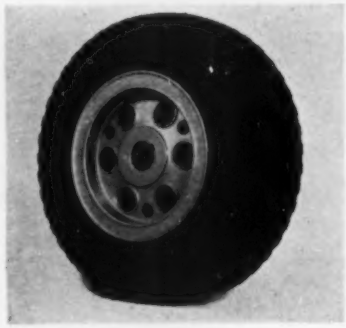
charge current and 30 to 480 v ac rms. Size varies according to amount of current discharge, and power drawn is said to be insignificant (a 210-v unit draws less than 1.05 w in normal operation). Under normal surge conditions, unit can discharge safely as much as 1000 times the current it draws at normal voltage. **Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30.**

Circle 319 on Reader Service Card



Magnesium wheels . . .

are reportedly lighter than aluminum and as strong as conventional steel wheels. Equipped with tire-gripping devices to prevent tire slippage during hard braking, acceleration and cornering. Available in 4-, 5- and 6-in. sizes to fit standard pneumatic tires; with either ⅜-in. bore sealed ball bearings or ⅝- or ¾-in. bore tapered-roller bearings. Prices are said to be competitive with steel wheels. **Go-Power Corp, PO Box 613, Palo Alto, Calif.**

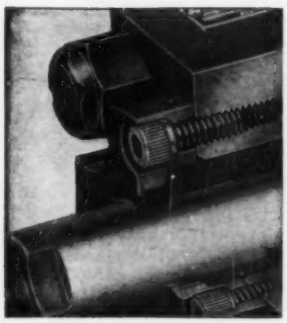
Circle 320 on Reader Service Card

Pressure transducer . . .

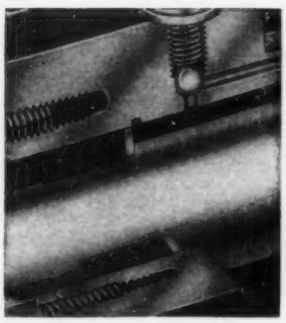
using a silicon semiconductor strain-gage sensor, produces a 250-milliv output without an amplifier with 10- to 30-v dc excitation. Available in airborne and ruggedized models, unit is responsive to both static and high-frequency dynamic pressures. Pressure range is 0-100 through 0-10,000 psi gage or absolute with allowable overpressure of 1.5 times rated full-scale pressure giving a zero shift of less than ±0.25%. Standard linearity is 0.25% max through zero and 100% pressure points (also available with 0.1% max). Standard hysteresis is 0.3% max with 0.15% max available in special units. Operating temp range is −65 to 125 F; compensated temp range, 0 to 150 F (compensation available over all or part of operable range on request). Withstands vibration output on all axes of 35 g's, 0 to 2000 cps sinusoidal. Output error due to vibration is less than 0.01% per peak g. Acceleration error on all axes is

continued on page 56

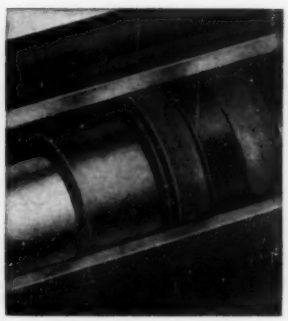
Do the cylinders you buy include these quality features?



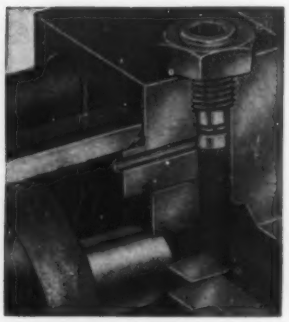
ROD GLAND—Easily removed. No need to loosen tie rods. Cuts maintenance time in half. Phenolic bearing insert will not score rod. Cuts replacement cost to a minimum.



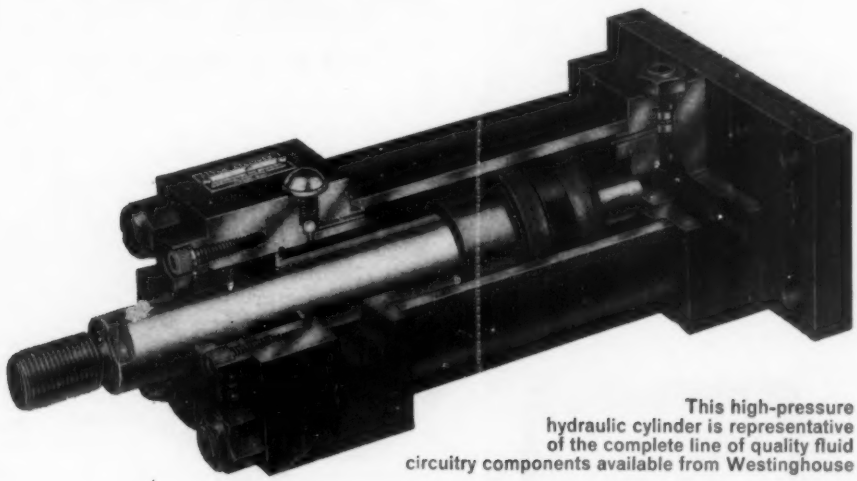
ROD PACKING—Interlocking multiple lip seals require no adjustments; remain flexible under fluid pressure. Wear compensating function eliminates frequent replacement.



PISTON—Phenolic piston will not score tube. Packing cups used for proven long life and seal. Cups are easily replaced. Piston positively locked to rod.



CUSHION—Minimum clearance between piston and Meehanite Bushing combined with micrometer metering gives top cushioning efficiency and a wide adjusting range.



This high-pressure hydraulic cylinder is representative of the complete line of quality fluid circuitry components available from Westinghouse

if not, the chances are, your maintenance costs are higher than necessary. For more information about Quality Fluid Circuitry Controls for trouble-free automation, ask for Catalog A3-56.00.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor, or refer to Sweet's Catalog, Product Design File.

WESTINGHOUSE AIR BRAKE COMPANY

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less than ±0.01% per g force, and unit withstands force of 1000 g's without damage. Airborne model is 2.4 in. long and 1.2 in. dia. Other model has same length but is 1.5 in. dia. Weight of former is ¼ lb; latter, approx 1 lb. **Fairchild Controls Corp, 219 Park Ave, Hicksville, LI, NY.**

Circle 321 on Reader Service Card

Vacuum transfer relay . . .

is SPDT unit with special coil and contacts that allow operating speeds of 100 cps for minimum of 10 million operations. Operate time is 3 millisec max; release time, 5 millisec max. Many of the units are reported to have operated over 2 hundred million cycles. Vacuum dielectric permits voltage rating of 18 kv peak test and current rating of 15 amp rms (60 c) in the 2¾-in. package. Will interrupt 18 kw dc power for over 100,000 operations if current or voltage does not exceed 3 amp or 6 kv. Also available in coaxial housing with choice of connectors for different power level requirements. **Jennings Radio Mfg Corp, PO Box 1278, San Jose 8, Calif.**

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Multipurpose pyrometer . . .

has three scale ranges: 32-2400 F and 0-1370 C for use with chromel-alumel thermocouples and 0-50 milliv when used as a millivolt meter in non-pyrometric applications. Said to have high internal resistance which assures sensitivity to smallest variances in temperature and is unaffected by different thermocouple lengths. Unit is mounted in 5.58 x 4-in. case. Scales are 3½ in. long. Conversion tables are included for use with iron constantan, chromel-constantan and copper-constantan thermocouples. Priced at $26. **Edmund Scientific Co, Barrington 50, NJ.**

Circle 323 on Reader Service Card

Dc servomotor . . .

is 4P, explosionproof, intermittent-duty unit, suitable for high-altitude applications. Includes treated brushes and qualifies according to applicable portions of MIL-M-8609A and MIL-E-5272. Typical ratings: 0.5 hp; 27 v dc field voltage; 0 to 90 v dc armature voltage; and 10,000 rpm speed. Weighs 15 lb, 8 oz. **Kearfott Div, General Precision Inc, 1150 McBride Ave, Little Falls, NJ.**

Circle 324 on Reader Service Card

Teflon slip-ring assembly . . .

consisting of molded Teflon shell filled with epoxy, is said to handle very high voltages without characteristic arcing damage even under extreme humidity. At same time, assembly reportedly maintains very high resistance between circuits and offers extreme inertness throughout temp range of −328 to 392 F. **Electro-Tec Corp, 10 Romanelli Ave, South Hackensack, NJ.**

Circle 325 on Reader Service Card

Self-tapping insert kit . . .

for use in experimental and prototype work, includes representative selection of insert types and sizes, as well as seven different installation tools. Package also contains illustrated installation instructions and chart showing recommended drill sizes for using inserts sized from No. 4 to ⅝ in. in various materials. Priced at $25.50. **Groov-Pin Corp, 1125 Hendricks Causeway, Ridgefield, NJ.**

Circle 326 on Reader Service Card

Revolving-disk sliderule . . .

can be operated with one hand, leaving other free to write down figures, make notes, etc. Has same moving scale principle as straight rule but eliminates resetting required by running off scale. Also eliminates extra settings required by conventional circular sliderules. Six models are available, each with scale arrangement suited to certain types of work. Prices range from $1.75 to $5.50. **Fullerton Engineering Sales Co, 4623 York Blvd, Los Angeles 41.**

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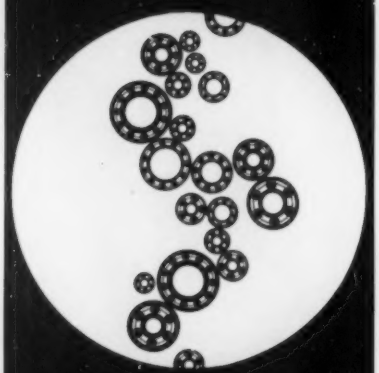

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DESIGN LITERATURE

Viscoelastic Properties of Polymers

JOHN D FERRY, Professor of Chemistry, Univ of Wisconsin. John Wiley & Sons Inc, 440 Park Avenue South, New York 16. 6¼ x 9¼, 482 pp. $15.

The author carefully develops a discussion of the theory of viscoelasticity, followed by the presentation of a wide variety of experimental methods and a critical appraisal of their applicability to polymeric materials of different characteristics. The existing state of molecular theory is reviewed and used to interpret the effects of temperature, chemical structure, dilution (plasticization), and other variables.

Several chapters are devoted to the dependence of viscoelastic properties on chemical composition, molecular weight, presence of diluents, and other features for several characteristic classes of materials. The book ends with illustrations of the many potential applications to practical problems in the processing and use of rubbers, plastics, and fibers, and the control of vibration and noise. This volume is recommended for the reader who, though using PRODUCT ENGINEERING articles on high-damping materials (see Apr 17 '61 and Jan 25 '60), desires more background in the subject.

—FRP

Field Theory for Engineers

PARRY MOON AND DOMINA EBERLE SPENCER. D Van Nostrand Co Inc, Princeton, NJ. 6¼ x 9¼, 530 pp. $12.75.

Ordinarily the one-dimensional treatment common in studies of magnetism, heat conduction, mechanical vibrations, and acoustics falls short where the phenomena spread out in three dimensions. Circuit concepts may be of great practical value as approximations; but a more basic approach is increasingly desirable as engineering becomes more precise and more ramified.

Field-theory problems can be handled by a number of methods, including transformations in the complex plane, numerical approximations, and experimental methods. By far the most powerful technique, however, employs separation of variables. This is the principal method treated in the book. Typical topics covered are: Orthogonal Functions; Cylindrical and Spherical Coordinates; Prolate and Oblate Spheroidal Coordinates; The Poisson Equation, Bessel and Laplace Functions, and The Diffusion Equation. There are many illustrations of mapping techniques.

The book is an outgrowth of mimeographed notes used in the Electrical Engineering Dept at MIT for the past 10 years.

Basic Transistors

ALEXANDER SCHURE. John F Rider Publisher Inc, NY. 6 x 9, 146 pp.

Text (highschool and college undergraduate level) is highly pictorialized and presents only one important concept per page. "Question" and "Problem" pages appear throughout the volume to emphasize the major points presented. This simplified, heavily pinpointed approach makes *Basic Transistors* readily understandable without an instructor, and suitable for individual as well as classroom study. Coverage ranges from the structure of atoms to the characteristics and circuitry of recently developed transistor types.

ABSTRACTS FROM THE LITERATURE

Producing Synthetic Alloys

The effect of compacting pressure, sintering temperature and sintering time on compound alloys from the soft low melting metals (tin, magnesium, zinc, lead, cadmium and bismuth) with WC and TiC is investigated on the basis of the density values.

"Attempts at Producing Synthetic Composite Alloys," by D. E. Gucer, Div of Engineering, Brown University, Providence, RI, Planseeberichte fur Pulvermetallurgie, Dec 1960, p 119.

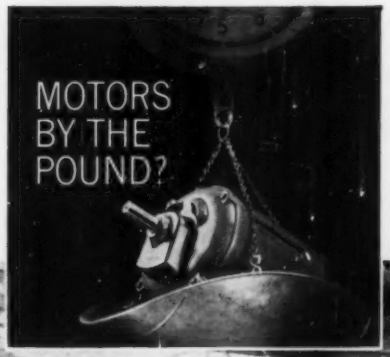
Fungus Testing

The destructive nature of fungi is manifested in many ways, some more critical than others. For example:

(1) They may attack products, making them unsightly and leaving a significant objectionable odor.

(2) They may attack and deface la-

continued on page 61



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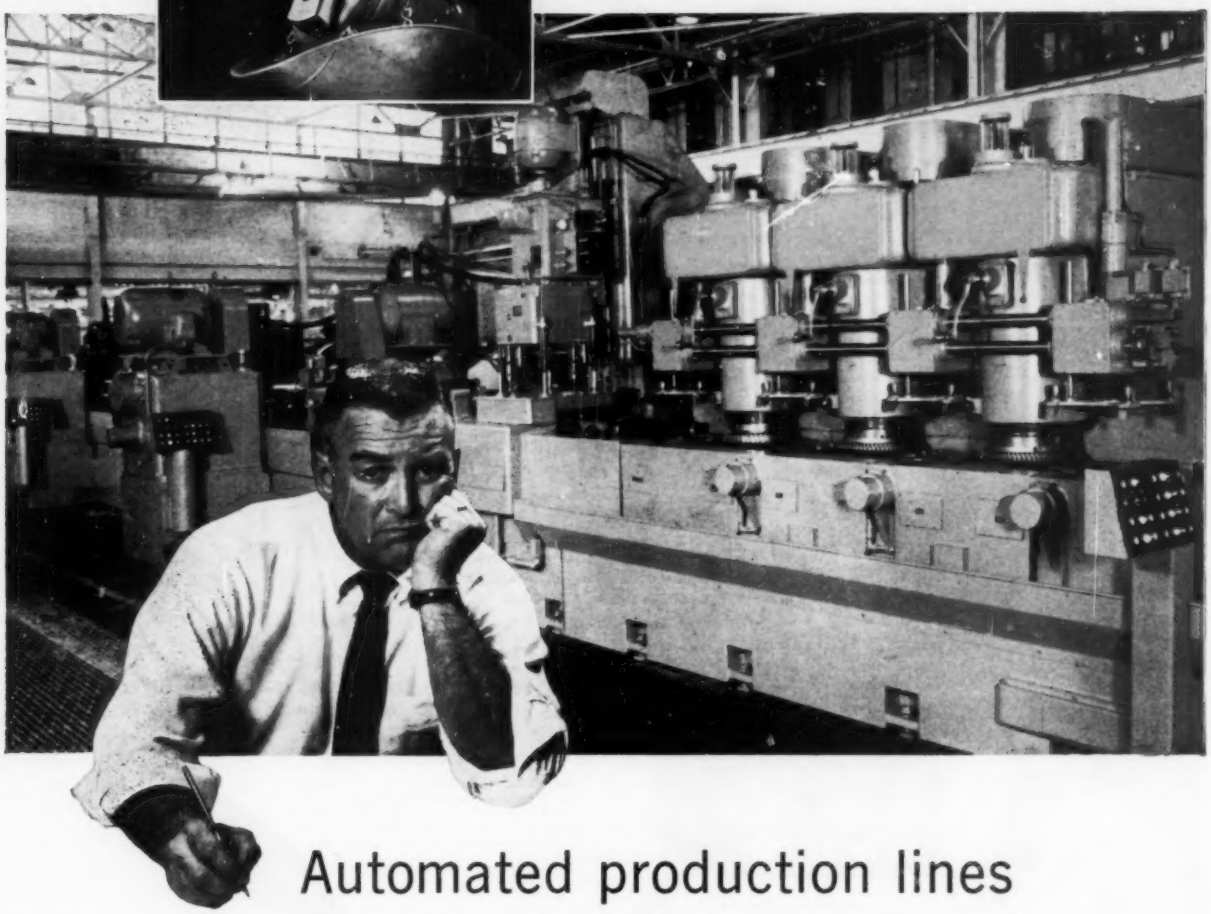

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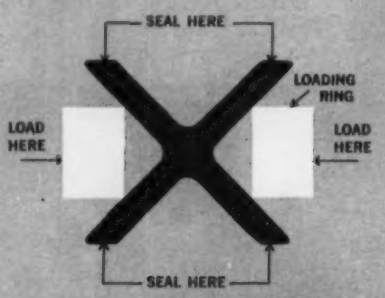

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beling or other essential instructional information placed on a product.

(3) They may attack and lessen the tensile strength and durability of a product, causing it to fall short of the time indicated in endurance testing.

(4) They may, in their metabolic activity, emit organic acids that etch or in some way disfigure a wanted smooth or polished surface.

(5) They may grow over the straining pores of filters, forming a closed mat to plug the filter pads.

"A-B-Cs of Fungus Testing," by Frank E. Swatek, PhD, staff consultant, American Laboratories Div, American Electronics Inc, Fullerton, Calif, Environmental Quarterly, Jan 1961. 252-46 Leeds Road, Little Neck 62, N.Y.

Time-series Charts

Time-series charts are a family of charts that engineers have found to be increasingly useful in recent years. Until a short while ago, these charts had been of use mainly to technically trained but non-engineering specialists, such as economists, statisticians and financial analysts.

The time-series chart (or graph) is an historical record showing the course of events. This chart is continually useful as a record of events over a period of time. Frequently time-series charts are useful also as a means of analysis and projection. Unlike scientific graphs, they do not present direct evidence of physical laws in action, but they are a valuable—and often necessary—adjunct to many scientific and semi-scientific endeavors.

"How to Make a Time-Series Chart," by Kenneth W. Haemer, Supervising Statistician, American Telephone and Telegraph Co. Presented in "The Magazine of Standards," Aug 1960. American Standards Assoc., 10 E. 40th St., NY 16.

Inserts in Polyethylene

Insert molding is the integral incorporation of metal pieces in the molded part during the actual machine production cycle of the injection molding process. These inserts are, for the most part, functional rather than decorative. The most common are internally threaded inserts molded into bosses on the back of a panel so that the panel may be assembled to another part by means of threaded metal bolts or screws. Another category of application is encountered where plastic

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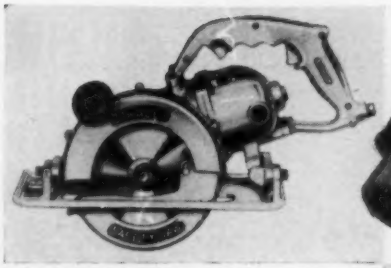

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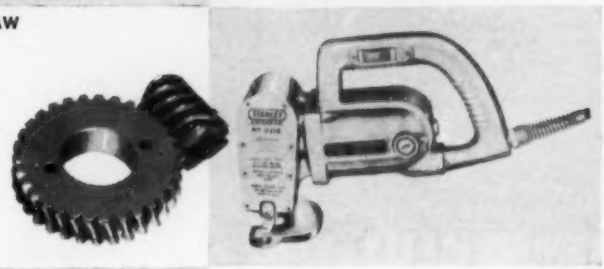

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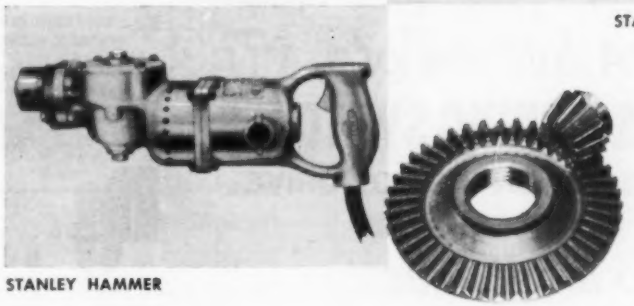

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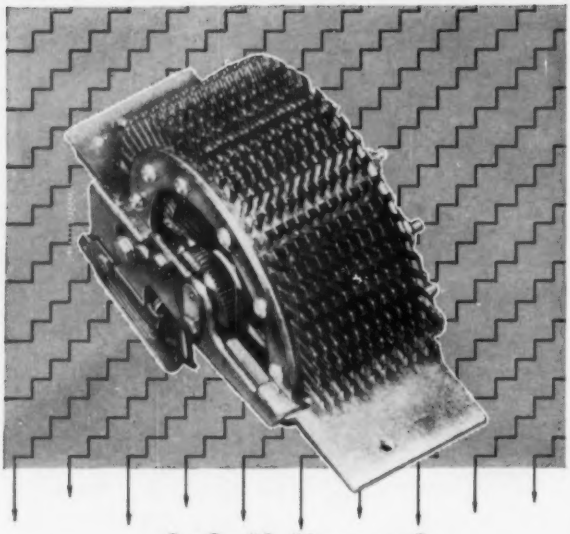

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must be molded around a supporting and reinforcing structural piece such as steering wheels, handles and miscellaneous industrial parts.

This paper describes insert molding with high density ethylene homopolymers of 0.96 density varying in melt index from 0.7 to 2.5, and copolymers of 0.95% density varying in melt index from 0.8 to 2.5.

Lessons for the insert molder are: Higher melt index materials can be molded with less strain, don't go below 0.125 in. in wall thickness, eliminate or reduce the thickness of any knurling on inserts, aluminum and brass inserts are preferable to steel.

"Insert Molding with High Density Polyethylene," by W. L. Price and W. A. Hunter, Celanese Plastics Co, SPE Journal, July 1960, Society of Plastics Engineers, 65 Prospect St, Stamford, Conn.

Externally Pressurized Step Journal Bearings

An externally pressurized gas journal bearing which achieves its load carrying capability by utilizing flow throttling dams parallel to the direction of rotation is discussed in this paper. Test procedures and equipment used to develop this bearing concept are described. A theoretical method of determining pressure distribution and load carrying capacity for the bearing is presented and correlated with experimental data for nonrotating shafts. Experiments showing the behavior of the bearing under shaft whirl conditions are described and illustrated. Suggested ranges of the design parameters are indicated. The paper also points out advantages

continued on page 65

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"Externally Pressurized Step Journal Bearings," C. R. Adams, J Dworski, E. M. Shoemaker, the Boeing Co. American Society of Mechanical Engineers, 61-LUBS-8, 29 W 39th St, NY 18.

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To obtain copies of literature described below, circle corresponding number on postcard inside back cover.

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SHEAR-PIN SPROCKETS—Bulletin 6119P, 8 pp. Tabulates dimensions, working loads and specifications of sprocket-and-hub combinations. Also contains drawings and formulas for selecting the stock sprockets. Chain Belt Co, Milwaukee 1.

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GLASS-TUBE FLOWMETERS—Catalog 520.100, 20 pp. Traces design features of an improved version of the variable-area flowmeter and describes and illustrates several available tube and float types. Carries capacity, dimension and material recommendation tables; dimension drawings; and operating pressure chart. Wallace & Tiernan Inc, 25 Main St, Belleville, NJ.

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PRESSURE TRANSDUCERS—Bulletin 278, 6 pp. Describes design principle upon which bonded strain gage devices are based; outlines their functions and advantages; and explains how aircooled and watercooled models operate. Includes typical performance table; selection chart covering 14 basic models with max pressure limits for each; variety of available strain gage bridge designs and threads; table of cable and connector assemblies; and list of mating connectors. American-Standard Controls Div, 5900 Trumbull Ave, Detroit 8.

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TEFLON SHAPES—Catalog TFE-359, 8 pp. Lists sizes, permissible tolerances, properties and end uses of sheets, rods, tubing, tapes, large diameter molded bars and cylinders. Cadillac Plastic & Chemical Co, 15111 Second Blvd, Detroit 3.

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SINTERED TITANIUM—Bulletin 100, 4 pp. Pinpoints potentials of material in modern design, outlining specifications and tolerances, grades available, physical properties, and limitations. Pictures typical end uses. Mechanical Research Div, Clevite Corp, 540 E 105th St, Cleveland 8.

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DIFFERENTIALS, END GEARS—Folder, 4 pp. Covers solid and hollow shaft differentials in wide and narrow design, supplying specifications, dimensions and dimension drawings. Tables carry data on precision end gears for 96, 72, 64 and 48 diametral pitch. Instru-Lec Corp, 520 Homestead Ave, Mt Vernon, NY.

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CARBON-GRAPHITE MATERIALS—Brochure, 8 pp. Presents concepts in use of materials for machine design, discussing and illustrating with curves and photos high elastic modulus, total impermeability, maintained flatness, resistance to chemical attack, thermal conductivity and low friction and wear. Tables show physical properties and recommended grades for seals and sliding surfaces. National Carbon Co, Div of Union Carbide Corp, 270 Park Ave, New York 17.

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PRECISION INVESTMENT CASTINGS—Booklet, 14 pp. Reviews both benefits and limitations of the "lost wax" investment casting process. Discusses basic design principles and lists physical properties and uses of several popular metals. Midwest Precision Castings Co, 10703 Quincy Ave, Cleveland 6.

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RESIN FOR NEOPRENE ADHESIVES—Bulletin, 4 pp. Outlines physical properties, handling characteristics, etc. of light-colored, heat-reactive phenolic resin. Included are discussions and curves depicting tensile shear, peel back and pre-reacting resin test data. Schenectady Varnish Co Inc, Schenectady 1, NY.

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SILICONES FOR ELECTRICAL INSULATION—Bulletin CDS-288, 8 pp. Reviews use of silicone varnishes for impregnating and protective coatings; clear and opaque potting and encapsulating materials; pressure sensitive adhesives; dielectric fluids; dielectric greases; wire and cable insulation, etc, giving typical electrical properties of each. Silicone Products Dept, General Electric Co, Waterford, NY.

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AUTOMATIC RESET DIAL TIMER—Bulletin N-305B, 8 pp. Covers construction, installation, application, specialized functions and electrical data. Includes six basic circuit arrangement diagrams and

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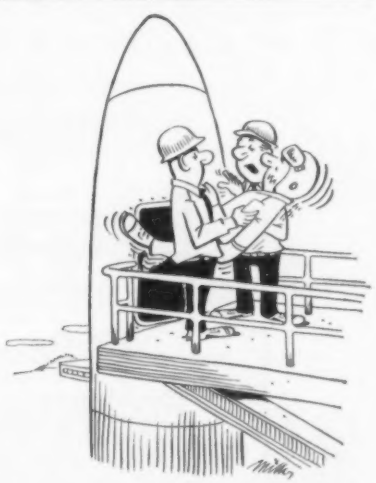

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ELECTRONIC TIMER—Bulletin 120, 4 pp. Carries typical applications, features, operating principle, eight circuit diagrams with complete descriptions, dimension drawings, etc. of instrument suitable for uses involving automatic operation of electric circuits at preselected, adjustable time intervals and sequences. Farmer Electric Products Co Inc, 2300 Washington St, Newton Lower Falls, Mass.

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SELF-BONDING RUBBER – Bulletin SE-5504U, 4 pp. Discusses applications for the silicone rubber compound and describes technique for obtaining primerless bonds to ferrous-containing metals. Several tables show typical properties. Silicone Products Dept, General Electric Co, Waterford, NY.

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SPUN END PULLEYS—Bulletin 1160, 8 pp. Describes and illustrates design features and tabulates dimensions and weights. Curves show load ratings and comparison of belt training effects for various pulley types. Stephens-Adamson Mfg Co, Aurora, Ill.

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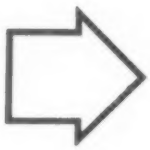

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*MULTIPLE PRODUCT ADS

Key No.	Specific Product

FOR YOU: USEFUL NEW DESIGN IDEAS!

Have *your personal* copy of PRODUCT ENGINEERING sent each week to your office or home. ACT NOW. Fill out this card today. Don't miss a single issue.

U.S. only ☐ **1 year—NOW $3** ☐ **2 years—NOW $4**

Canada **1 year—$5** **2 years—$8**

☐ Payment Enclosed ☐ Bill me

Name..... Your Title.....

Home ☐ .....

Address Office ☐ .....

City..... Zone..... State.....

Company Name..... Your Dept.....

Products Mfgd. or Designed.....

Please check your job function:

☐ Product Design Engineering ☐ Research & Development Engineering

☐ Manufacturing

☐ Administrative Engineering ☐ Company Management

U.

THIS WEALTH OF VITAL INFORMATION . . .

NEW COMPONENTS

GENERAL ENGINEERING

326—Self-tapping Insert Kit
327—Revolving Disk Sliderule

METALS AND ALLOYS

307—Welded Roll

NON-METALLIC MATERIALS, FINISHES

305—Linear Polyolefin Resins
306—Polycarbonate Resins
311—Filament-wound Parts
313—Polyethylene Tubing

FABRICATION PROCESSES AND PRODUCTION

305—Linear Polyolefin Resins
307—Welded Roll
311—Filament-wound Parts

POWER TRANSMISSION

304—Kisk Brake

MECHANICAL PARTS

314—All-steel Pillow Block
320—Magnesium Wheels
325—Teflon Slip Ring Assembly

FASTENING AND JOINING

301—4 Small Diameter Nut
302—Two-part Epoxy Adhesive

ELECTRICAL, ELECTRONIC COMPONENTS

300—Electrothermal Actuator
308—Rotary Connector
314—All-steel Pillow Block
318—Motor-mounted Rotary Pumps
324—Dc Servomotor

ELECTRICAL, ELECTRONIC COMPONENTS

300—Electrothermal Actuator
308—Rotary Connector
309—Miniature Indicator Light
310—Digital Readout Assembly
319—Surge Suppressor
321—Pressure Transducer
322—Vacuum Transfer Relay
323—Multi-Purpose Pyrometer
324—Dc Servomotor

HYDRAULIC, PNEUMATIC EQUIPMENT

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312—Air/oil Valve Actuator
313—Polyethylene Tubing
315—250-psi Cylinders
316—Packless Globe Valves
318—Motor-mounted Rotary Pumps
321—Pressure Transducer

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357—Carbon-graphite Materials, 8 pp, National Carbon Co, Div of Union Carbide Corp

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354—Teflon Shapes, 8 pp, Cadillac Plastic & Chemical Co
359—Resin for Neoprene Adhesives, 4 pp, Schenectady Varnish Co, Inc
360—Silicones for Electrical Insulation, 8 pp, General Electric Co
370—Self-bonding Rubber, 4 pp, General Electric Co

FABRICATION PROCESSES AND PRODUCTION

358—Precision Investment Castings, 14 pp, Midwest Precision Co

POWER TRANSMISSION

350—Gearheads, Speed Reducers, 28 pp, Superior Mfg & Instrument Corp
356—Differentials, End Gears, 4 pp, Instru-Lec Corp
371—Spun End Pulleys, 8 pp, Stephens-Adamson Mfg Co

MECHANICAL PARTS

351—Shear Pin Sprockets, 8 pp, Chain Belt Co
361—V-ring Wear, 2 pp, Greene, Tweed & Co
368—Medium Duty Casters, 4 pp, Payson-Harris & Reed Inc

FASTENING AND JOINING

359—Resin for Neoprene Adhesives, 4 pp, Schenectady Varnish Co, Inc
370—Self-bonding Rubber, 4 pp, General Electric Co

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366—Automatic Reset Dial Timer, 8 pp, Automatic Timing & Controls Inc

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360—Silicones for Electrical Insulation, 8 pp, General Electric Co
362—Switches, 4 pp, Donald P Mossman, Inc
363—Temperature Transducers, 4 pp, Trans-Sonics Inc
366—Automatic Reset Dial Timer, 8 pp, Automatic Timing & Controls Inc
367—Silicon Rectifiers, 7 pp, Solitron Devices Inc
369—Electronic Timer, 4 pp, Farmer Electric Products Co, Inc

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353—Pressure Transducers, 6 pp, American-Standard Controls Div
364—High Pressure Hose Fittings, 6 pp, Aeroquip Corp
365—Lubricated Plug Valves, 16 pp, Walworth Co

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Name.....Title.....

Street.....

City.....Zone.....State.....

Company.....Major Product Manufactured.....

1	21	41	61	81	101	121	141	161	181	201	221	241	261	281	301	316	331	346	361	376
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Issue of July 3, 1961
PRODUCT ENGINEERING
Card Expires September 4, 1961

FIRST CLASS
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NEW YORK, N. Y.

BUSINESS REPLY MAIL
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Inquiries Services Department
PRODUCT ENGINEERING
P.O. Box 601
Ridgefield, Connecticut

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Issue of July 3, 1961
PRODUCT ENGINEERING
Card Expires September 4, 1961

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

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No Postage Stamp Necessary If Mailed in the United States

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Inquiries Services Department
PRODUCT ENGINEERING
P.O. Box 601
Ridgefield, Connecticut

1

LOOK----------

it's all one piece!

Opening and closing this one-piece carrying case demonstrates the remarkable "hinge" property of TENITE POLYPROPYLENE

Flexed a million times in one continuous laboratory test, a molded specimen of Tenite Polypropylene—the Eastman plastic with the "built-in hinge"—showed never a crack. That's why this case can have its base, cover, and handle molded as a unit, with obvious savings in design, fabrication, and assembly.

Made for a child's typewriter, the case is well able to take slam-bang treatment that will come its way. The high abrasion resistance demonstrated in this use gives long life to the beauty of many products made from Tenite Polypropylene, and also suggests its use for gears, bearings, and similar hard-working parts.

In addition to being injection molded, Tenite Polypropylene can be extruded into film, sheeting, and monofilaments, and in special formulations is adaptable to blow molding, where its exceptional strength permits thin walls. The film is sparkling clear, heat-sealable, printable, and an effective moisture barrier—important features in packaging. Rigid sheet is readily thermoformed on standard equipment into large-scale sections or skin packaging.

As extruded wire covering, Tenite Polypropylene exhibits excellent electrical and thermal properties. And formulations combining weatherability, low-temperature flexibility, and high tensile strength may be used to produce monofilaments that are ideal for such applications as webbing for outdoor furniture.

With the lightest weight of any solid plastic, Tenite Polypropylene gives the greatest product yield per pound. As for colors, thousands of vibrant hues are available in Tenite Polypropylene—or in color concentrates for mixing with uncolored plastic to produce the desired color when molded or extruded. Eastman experience in coloring plastics extends over 25 years, with additional background in color photography and textile dyes. In applying this plastic to your product ideas, you can call on the aid of Eastman's technical representatives and its extensive laboratory facilities. For information on Tenite Polypropylene or any other plastics in the Tenite family—butyrate, acetate, propionate, or polyethylene—write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Carrying case molded by manufacturer of the "Tom Thumb" typewriter, Western Stamping Company, Jackson, Michigan.

TENITE®

POLYPROPYLENE

an Eastman plastic

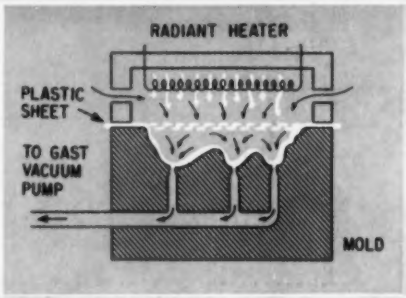
CIRCLE 202 ON READER SERVICE CARD

HOW TO APPLY *GAST* VACUUM PUMPS TO SOLVE PRODUCT DESIGN PROBLEMS

VACUUM FORMING OF PLASTIC SHEETS

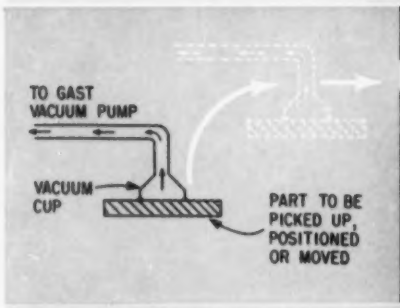
Many engineers are now pushing hard for improved designs on products used for: (1) Lower-cost parts forming, (2) materials feeding and (3) handling, (4) automatic control of machines, (5) faster testing and inspection. To suggest how Gast Vacuum Pumps (used as original components) might help you solve related problems, we offer these 5 examples:

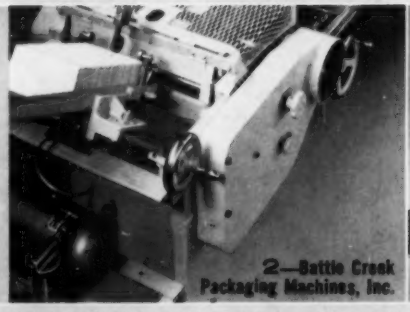
1. VACUUM FORMING of thermoplastic sheet materials. Suction from Gast Model 1065 Vacuum Pump "drapes" heated plastic over male or female mold to make packages, products, parts, etc.

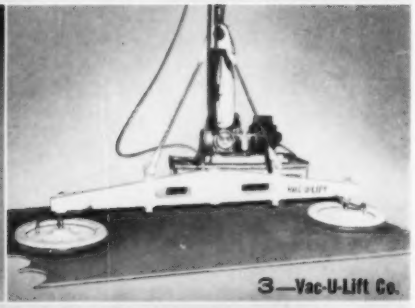


1—Comet Industries, Inc.

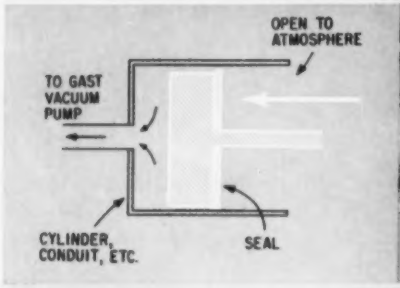
FEEDING OR HANDLING PARTS

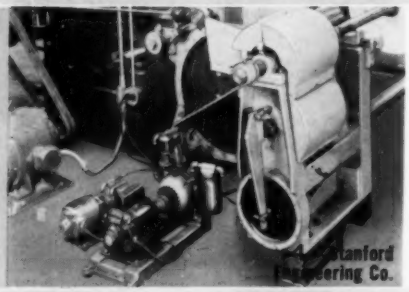



2—Battle Creek Packaging Machines, Inc.


3—Vac-U-Lift Co.

MOVE PISTON OR DIAPHRAGM FOR AUTOMATIC CONTROL




4—Stanford Engineering Co.

2. VACUUM FEEDER places U-board card into position on conveyor of cake wrapping machine. A ¼ h.p. Gast 0321 Integral-Motor Pump provides vacuum.

3. VACUUM HOIST handles flat stock in weights up to 1,000 lbs. per vacuum pad, using a ½ h.p. Gast Vacuum Pump. Safety device holds if power fails.

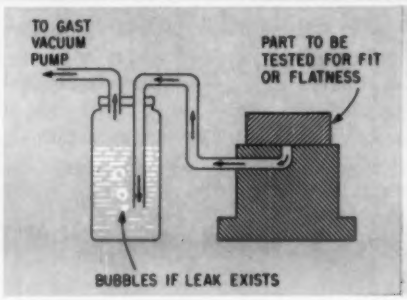
4. VACUUM WEB GUIDE for paper rolls prevents edge of paper from wandering, also keeps web tension constant. Two Gast Air Pumps activate controls.

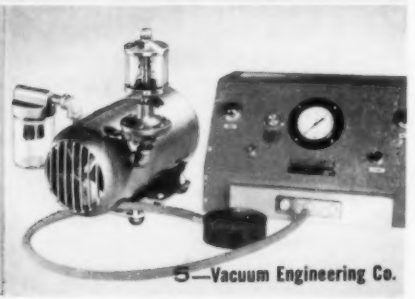
TESTING AND INSPECTION

WRITE FOR APPLICATION IDEAS BOOKLET—AND GAST CATALOG!

If the examples above interest you, request our "Application Ideas" Booklet. It contains 43 product stories like these, plus helpful diagrams on the uses of pneumatics.

"Air may be your Answer!"




5—Vacuum Engineering Co.

5. VACUUM TESTER checks surface flatness of parts against a standard. Vacuum level maintained by Gast 0321 Pump energizes "go" or "no-go" lights.

AIR MOTORS TO 7 H.P.

AIR COMPRESSORS TO 30 P.S.I.G.

VACUUM PUMPS TO 28" HG

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GAST MANUFACTURING CORP.
P.O. BOX 117-V, BENTON HARBOR, MICHIGAN

- ROTARY AIR MOTORS
- AIR COMPRESSORS
- VACUUM PUMPS

CIRCLE 203 ON READER SERVICE CARD